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SUBJECT: Distribution of EPD-180, Revision 1

Attached is the revised Surveyor Mission P-42 Space Flight Operations Plan, EPD-180. This supplants the issue dated 5 March 1964.

This document reflects, in general, the current state of planning for Surveyor space flight operations. Revisions will be issued as planning for the operations is developed further.

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ENGINEERING PLANNING DOCUMENT

NO. 180

# SPACE FLIGHT OPERATIONS PLAN

# SURVEYOR

# MISSION P-42

EPD-180, REVISION 1 24 JULY 1964

EPD-180 5 March 1964

APPROVED: W. F. Eichwald

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24 JULY 1964

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PASADENA, CALIFORNIA

# FOREWORD

It is the function of the Space Flight Operations Plan to define the method by which space flight operations will be conducted in both the standard case and in anticipated departures from the standard case. Space flight operations are defined as the operations necessary for obtaining and processing spacecraft information and for determining and executing spacecraft commands from launch to the accomplishment of the mission. This Space Flight Operations Plan covers the requirements for the Surveyor P-42 Mission. Operational facilities and support equipment are described, and the flow of data between facilities is outlined. Required sequences and procedures are specified for the standard case and for certain nonstandard situations.

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# SECTION I

# SPACE FLIGHT OPERATIONS

## A. MISSION OBJECTIVES

TO BE SUPPLIED AT A LATER DATE.

## B. LAUNCH VEHICLE AND SPACECRAFT DESCRIPTIONS

### 1. Launch Vehicle

A two-stage launch vehicle, consisting of an Atlas D first stage and a Centaur second stage, will boost the spacecraft in a direct ascent, powered flight path into the required translunar trajectory (see Figure I-1).

The Atlas propulsion system consists of twin booster engines, a single sustainer engine, and two vernier engines for attitude and velocity corrections. All engines are gimbal-mounted. Guidance will be from an autopilot controlled from the Centaur inertial guidance system.

The Centaur system is driven by two gimbal-mounted, liquid-hydrogen engines that provide 15,000 pounds of thrust each. Flight control for the Centaur is supplied by an inertial guidance system that also controls the autopilot for the first stage.

The first stage telemetry system transmits functional and environmental data on a VHF carrier. The second-stage telemetry system transmits both Centaur and spacecraft data on a VHF carrier. The Centaur carries a C-band beacon to permit ground tracking.

### 2. Spacecraft

The Surveyor spacecraft has a nominal weight of 2100 pounds and is designed to be mounted within an aerodynamic nose fairing atop the Atlas/Centaur launch vehicle. Three extendable legs provide a broad base for touchdown stability (see Figure I-2).

The Surveyor spacecraft structure provides mechanical support and a base for the various spacecraft subsystems.

The spacecraft has a guidance system that can maintain full attitude stabilization and that can direct the spacecraft through maneuvers in attitude and trajectory in response to commands from the ground. Cold gas jets position the spacecraft in the required attitude. In the optically stabilized mode, the spacecraft uses the Sun and Canopus as reference objects.

The spacecraft contains two propulsion systems: 1) a solid-propellant, main retro-engine that provides the primary braking during terminal descent, and 2) a variable, low-thrust, liquid-propellant system of three vernier engines capable of executing a midcourse trajectory correction and of providing braking and attitude control during terminal descent.

During the terminal sequence, the propulsion system is controlled automatically by a radar system that measures altitude and velocity components with respect to the lunar surface.

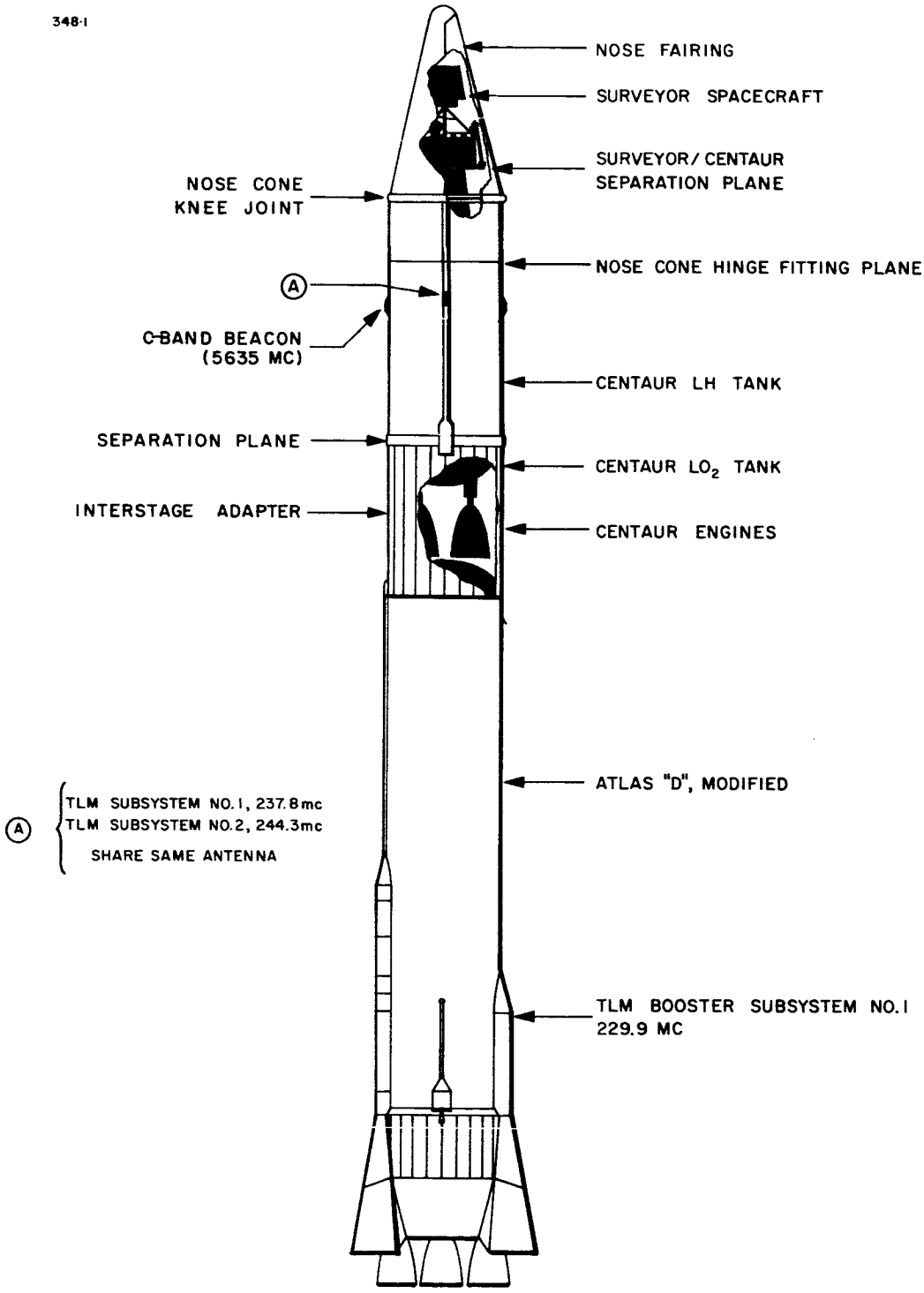
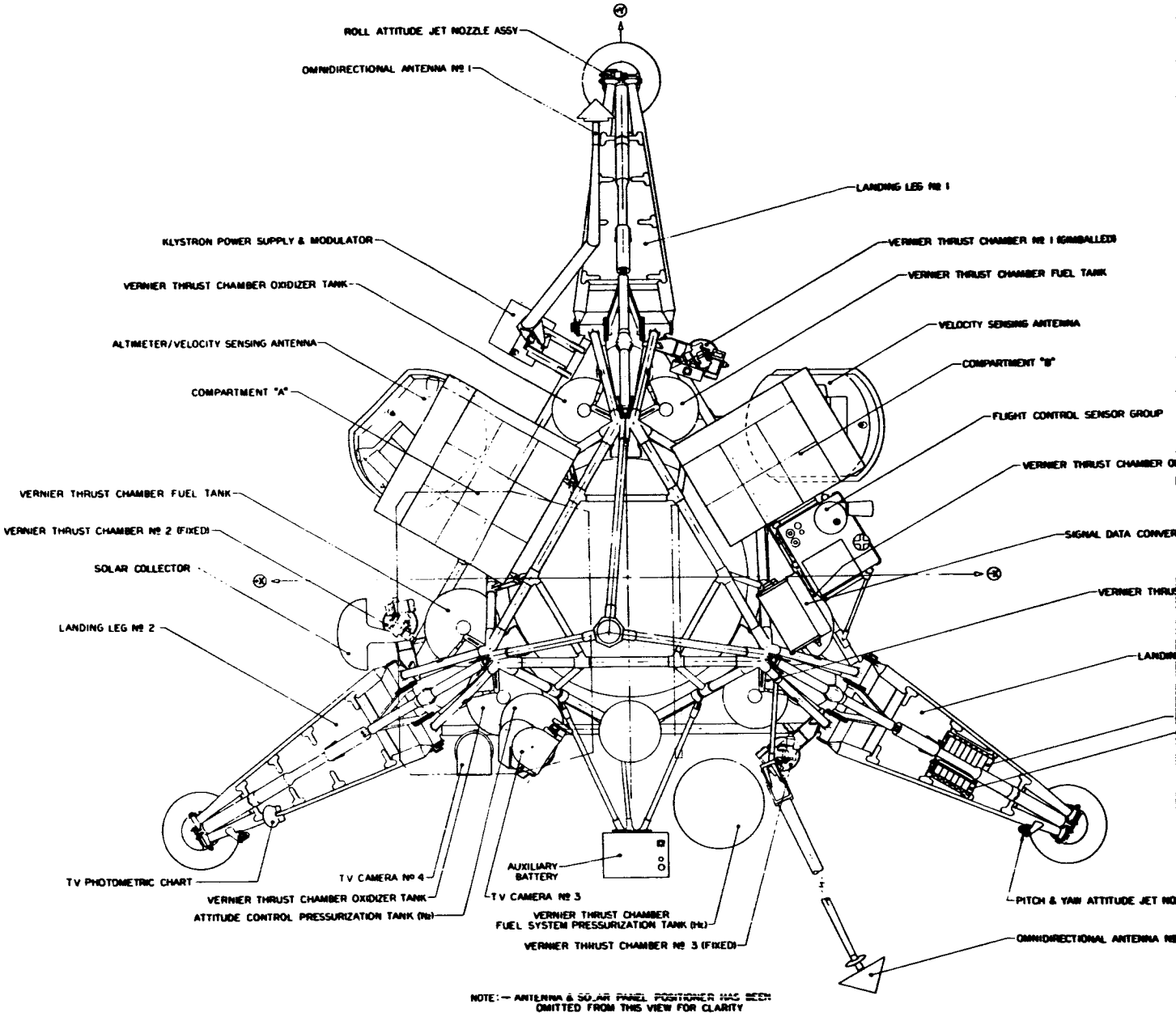



FIGURE I-1. ATLAS/CENTAUR/SURVEYOR CONFIGURATION (INFORMATION ONLY)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OMNIDIRECTIONAL ANTENNA № 1
LANDING LEG № 1
KLYSTRON POWER SUPPLY & MODULATOR
VERNIER THRUST CHAMBER № 1 (GIMBALLED)
VERNIER THRUST CHAMBER OXIDIZER TANK
VERNIER THRUST CHAMBER FUEL TANK
ALTIMETER/VELOCITY SENSING ANTENNA
VELOCITY SENSING ANTENNA
COMPARTMENT "B"
COMPARTMENT "A"
FLIGHT CONTROL SENSOR GROUP
VERNIER THRUST CHAMBER FUEL TANK
VERNIER THRUST CHAMBER № 2 (FIXED)
SOLAR COLLECTOR
LANDING LEG № 2
TV PHOTOMETRIC CHART
TV CAMERA № 4
VERNIER THRUST CHAMBER OXIDIZER TANK
ATTITUDE CONTROL PRESSURIZATION TANK (№)
AUXILIARY BATTERY
TV CAMERA № 3
VERNIER THRUST CHAMBER FUEL SYSTEM PRESSURIZATION TANK (№)
VERNIER THRUST CHAMBER № 3 (FIXED)
PITCH & YAW ATTITUDE JET NO
OMNIDIRECTIONAL ANTENNA NO
NOTE:— ANTENNA & SOLAR PANEL POSITIONER HAS BEEN OMITTED FROM THIS VIEW FOR CLARITY

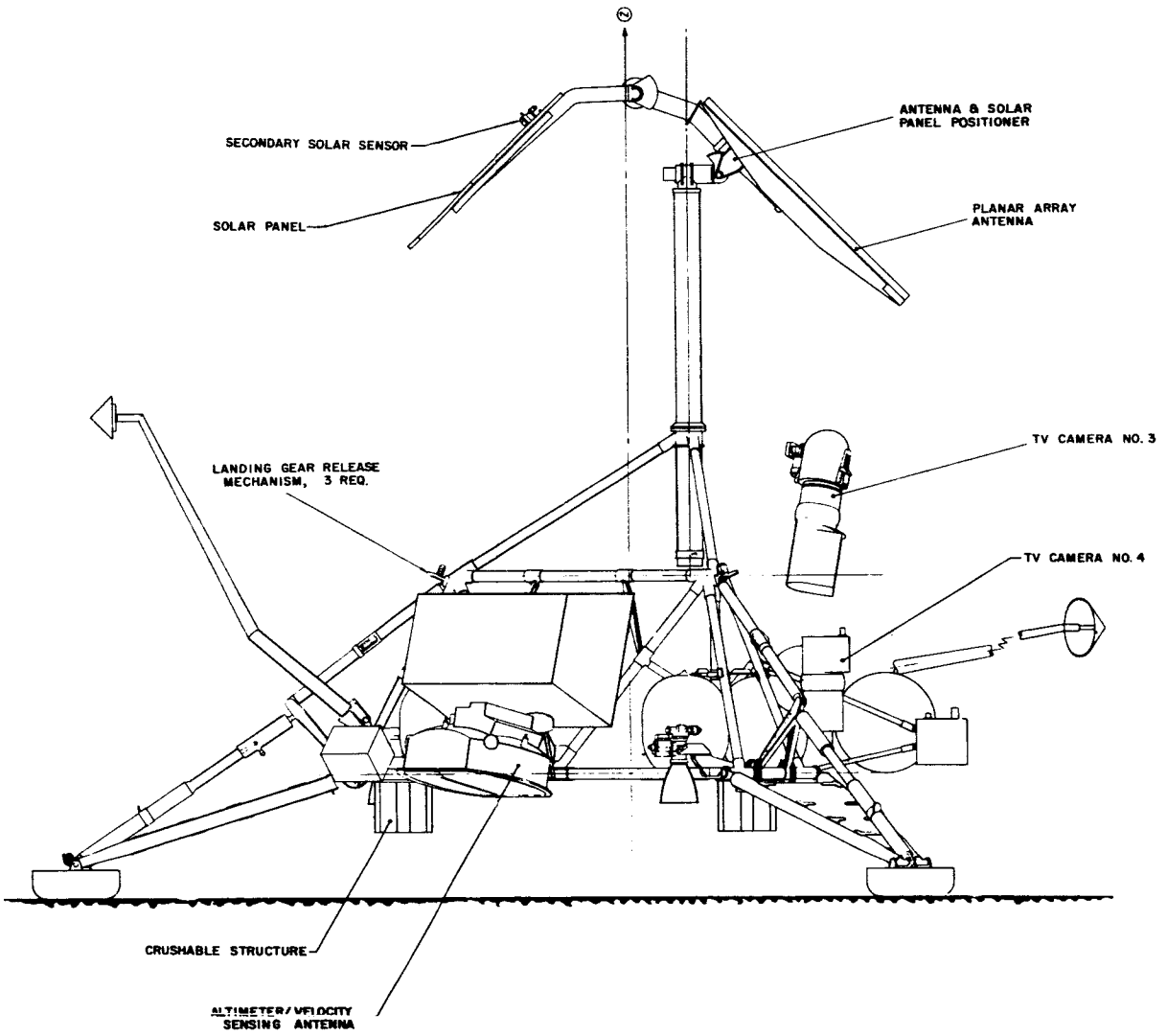


FIGURE I-2. SURVEYOR CONFIGURATION

The spacecraft has a two-way telecommunications system that provides: 1) a method of telemetering information to the Earth, 2) the capability of receiving and processing commands to the spacecraft, and 3) angle tracking and one- or two-way doppler for orbit determination.

Two receivers (for reliability) operate continuously. Commands pass through the receivers to the central command decoder, and are then routed to the subsystem decoder that controls a particular subsystem of the spacecraft, e. g., electrical power, flight control.

Either of two identical transmitters can be selected by ground commands. Each is capable of operating in either a high-power or a low-power mode in accordance with the bandwidth of the transmitted data. A signal processing system transforms television and engineering data signals into a form suitable for modulating the transmitter.

Highly accurate tracking of the spacecraft is obtained by spacecraft transponders that permit two-way doppler shift measurements. In this mode, one of the transmitters is phase-locked to one of the receivers through transponder interconnection circuitry, and the signal transmitted back to Earth is coherent with the received signal. Two transponder interconnection units are used for reliability.

There are three telecommunications antennas aboard the spacecraft: a high-gain directional antenna, the planar array, used only for transmission; and two omnidirectional conical antennas. The planar array orientation, with respect to the vehicle, is controlled by Earth commands. Each of the omnidirectional antennas is permanently connected through a diplexer to one of the spacecraft receivers. The omnidirectional antennas are positioned so that commands can be received regardless of spacecraft attitude.

The spacecraft derives its electrical power from a solar panel and two storage batteries. The solar panel furnishes power for functional use and for battery charging during transit and the lunar day. A primary 2640-ampere-hour battery or a reserve 1000-ampere-hour battery will supply power during the lunar night and during periods of peak load during transit.

The spacecraft will carry two television cameras: an approach camera, and a survey camera with scanning capability. The approach camera will take pictures during the approach to the Moon starting at an altitude of approximately 1000 miles. After touchdown, the survey camera will provide sequential frame surveys of the lunar surface. The survey camera has a motor-driven lens for focusing, and motor-driven mirrors for pan-and-tilt control.

## C. MISSION PROFILE

The spacecraft will be carried by an Atlas/Centaur vehicle through a direct ascent flight path and injected into a nominal 66-hour transit trajectory (see Figure I-3).

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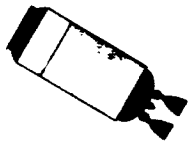

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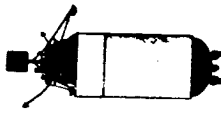

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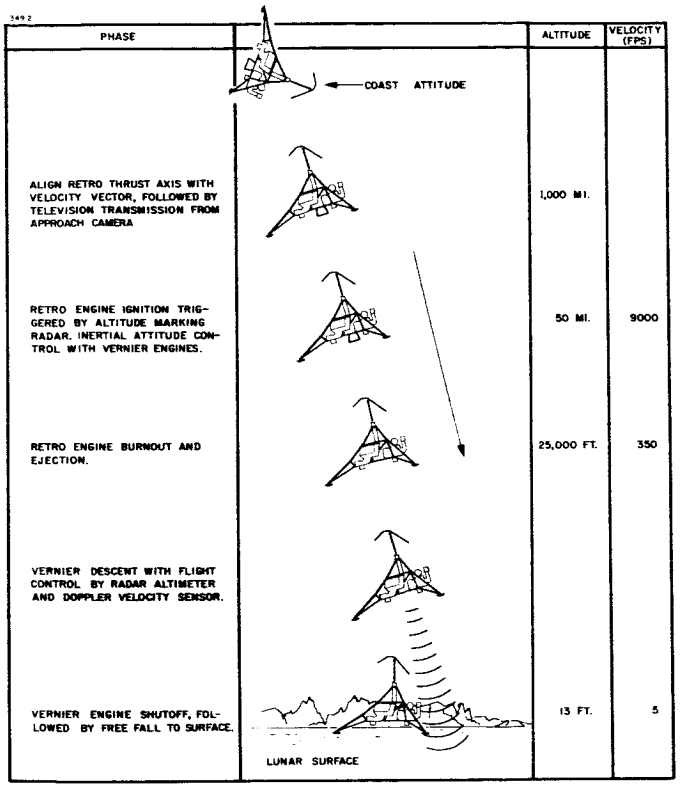



FIGURE I-3C. SURVEYOR TERMINAL D

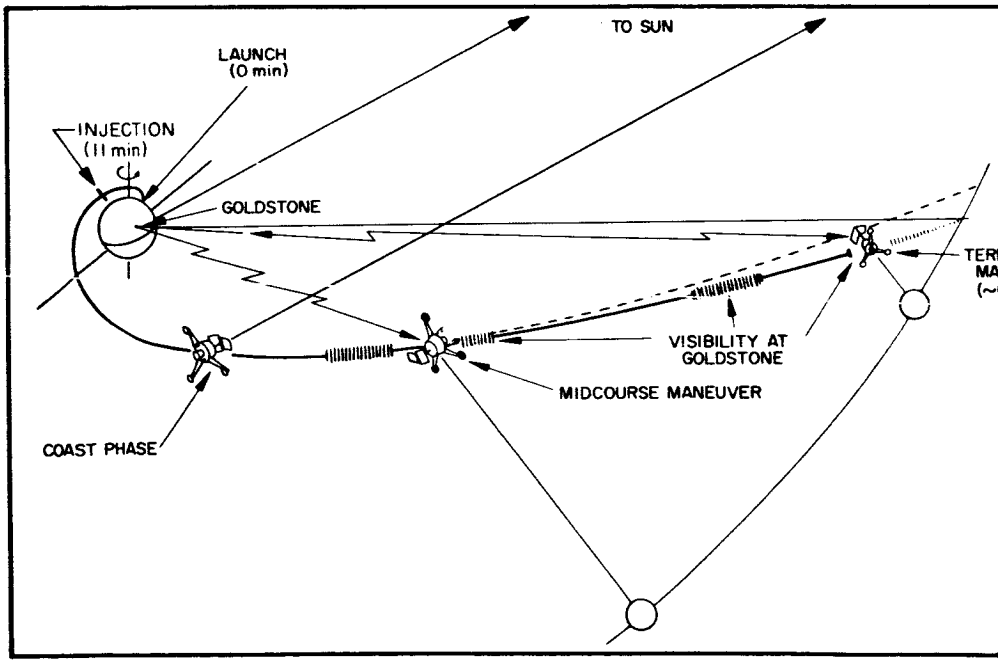
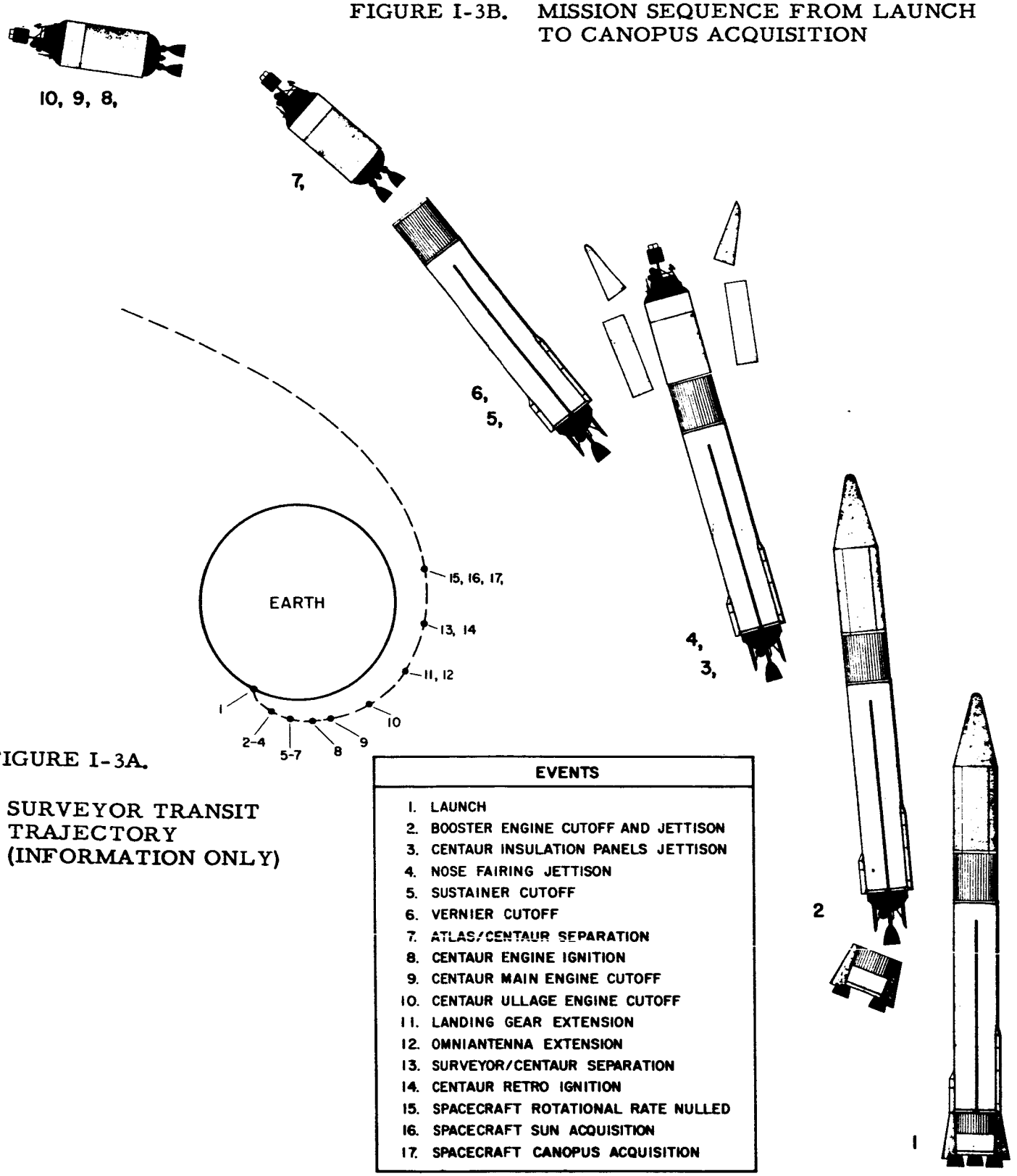


FIGURE I-3B. MISSION SEQUENCE FROM LAUNCH TO CANOPUS ACQUISITION




| EVENTS |
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FIGURE I-3A.

SURVEYOR TRANSIT TRAJECTORY (INFORMATION ONLY)

The Atlas booster engine cuts off and is jettisoned shortly after launch. Some time before the sustainer and vernier engines burn out, commands from the Centaur programmer will initiate ejection of the Centaur insulation panels and the spacecraft nose fairing. After sustainer and vernier engine burnout, the Centaur separates from the Atlas. The Centaur engines then ignite, drive the vehicle on into the transit trajectory, and cut off. The Centaur programmer commands extension of the spacecraft landing legs and the omnidirectional antennas and finally, separation of the spacecraft and Centaur. The spacecraft nitrogen jets null the rotational rates imparted during separation and maintain the spacecraft in this rate-stabilized mode until the initial Johannesburg DSIF acquisition.

After separation, the spacecraft automatically aligns the solar cell array perpendicularly to the vehicle roll axis; after DSIF acquisition, commands are sent to the spacecraft to acquire the Sun, thereby providing a fixed reference for orientation in the yaw and pitch axes. Before the midcourse correction is accomplished, Canopus must be acquired to provide fixed reference for orientation in roll. The midcourse correction maneuver will be executed approximately 15 hours after injection to bring the spacecraft into a trajectory terminating at the desired point on the lunar surface. This maneuver will be computed at JPL, Pasadena, from tracking information supplied by the DSIF.

As the first step in the terminal maneuver, the spacecraft roll axis is aligned along the velocity vector and the high-gain antenna is aligned toward Earth. Television viewing of the lunar surface begins about 10 minutes before impact. All radars are turned on approximately five minutes before predicted impact. Following a "command enabling" signal to the trigger radar, the landing sequence is automatic. At a slant range of approximately 50 miles from the Moon, the vernier control engines and the main retro-engine are ignited. The retro-engine separates from the spacecraft after burnout at a nominal lunar altitude of 30,000 feet. The vernier engines then operate under control of the doppler radar and the precision altimeter radar so as to slow the spacecraft velocity to about 5 feet per second at a 13-foot altitude. At this time, the vernier engines shut off, and the spacecraft free-falls to the surface.

The solar panel and planar array will be unlocked and properly oriented after landing. The post-touchdown condition of the spacecraft will be evaluated by sampling all modes of engineering data, and by attempting to manipulate spacecraft mechanisms. Television survey sequences will then be directed by ground commands.

The landing is planned to occur in a region near the Moon's equator where the angle between the unbraked, approach velocity vector and the local Moon vertical is approximately zero degrees. The spacecraft design provides landing capabilities for approach angles to 45 degrees with respect to the local Moon vertical; thus, landings can be accomplished in other maria in the western region of the face of the Moon as shown in Figure I-4. It is planned that the lunar landing be observed from the Goldstone station and that this visibility be maintained for a period of not less than three hours after landing.

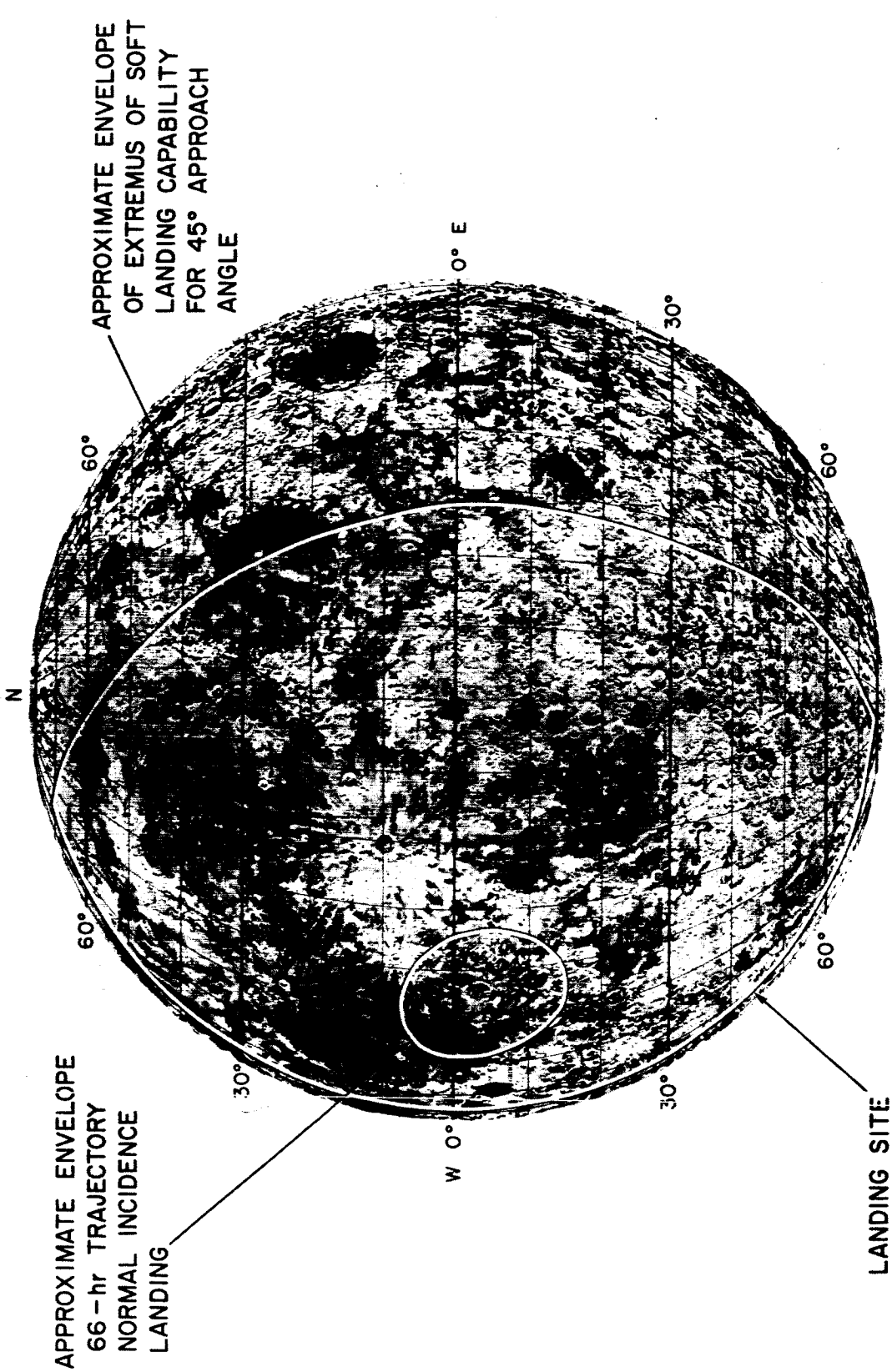



FIGURE I-4. SURVEYOR LUNAR LANDING AREAS

## D. OPERATIONAL ORGANIZATION

The Surveyor space flight operations organizational structure is shown in Figure I-5. Primary mission responsibilities and the authority of the individual organization members are as follows:

### 1. Project Manager

The Project Manager has the responsibility and authority for the execution, to completion, of the development and operation of the project.

### 2. Space Flight Operations Director

It is the function of the Space Flight Operations Director to support the Project Manager in the preparation and execution of the standard operating procedure for space flight operations, i.e., the Space Flight Operations Plan (SFOP). The standard operating procedure is defined as the method by which the space flight operations will be conducted in both the nominal case and in anticipated departures from the nominal case.

#### a. Preflight Phase

During the preflight phase, it is the responsibility of the Space Flight Operations Director, supported by appropriate JPL and HAC personnel, to coordinate and integrate requirements that are established by the cognizant divisions for the standard operating procedure to be followed during the inflight phase. The Space Flight Operations Director is empowered to request information and resolve conflicting requirements, within the framework of existing Laboratory structure and within the authority of the program, as required to fulfill this responsibility.

#### b. Inflight Phase

During the inflight phase, it is the responsibility of the Space Flight Operations Director to:

1) Interpret the standard operating procedure and place requirements consistent with this SFOP on the various operating groups.

2) Resolve any ambiguities directly associated with the standard operating procedure arising during its execution.

3) Make appropriate decisions requiring emergency action to ensure success of the mission if the Assistant Laboratory Director for Projects, the Project Manager, or the Assistant Project Manager for Mission Operations cannot be contacted.

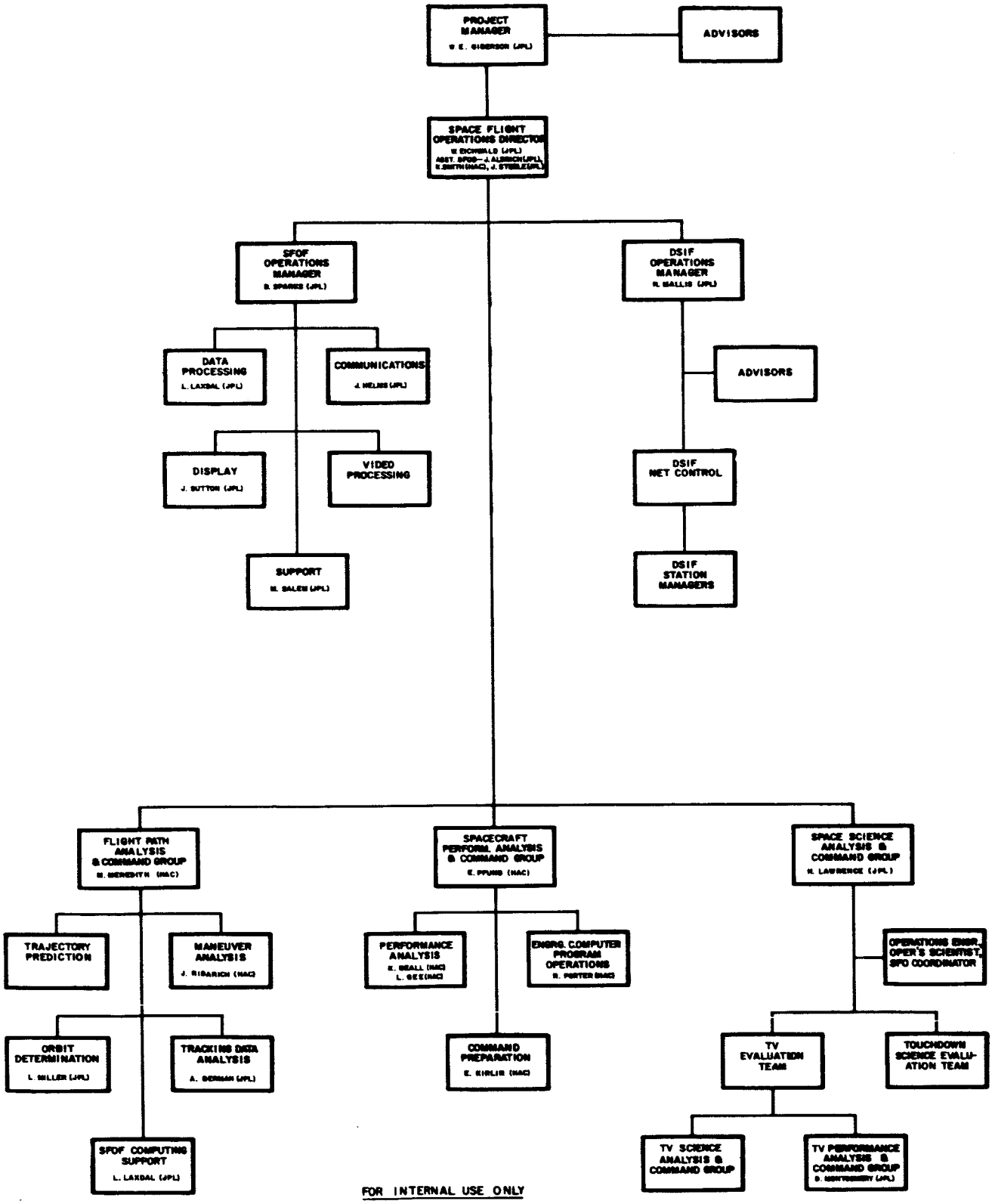



FIGURE I-5. SURVEYOR SPACE FLIGHT OPERATIONS ORGANIZATION

In the fulfillment of this responsibility, the Space Flight Operations Director is accountable to the Assistant Laboratory Director for Projects, the Project Manager, or to the Assistant Project Manager for Mission Operations, and is delegated authority of the Project Manager for placement of requirements on operating groups in accordance with the SFOP.

3. Advisors

It is the function of the advisors to be aware of the performance of the spacecraft system, of the instrumentation subsystem, and of the DSIF during flight, and to supply judgments to the Project Manager as to possible future courses of action in the event of nonstandard behavior of the spacecraft.

4. SFOF Operations Manager

It is the responsibility of the SFOF Operations Manager to direct the operation of the SFOF during space flight operations and to commit and control all functions in the SFOF during the preparation and execution of each flight operation.

a. Data Processing Project Engineer

It is the responsibility of the Data Processing Project Engineer to commit and control the data processing, conversion, distribution, and display equipment and personnel during the preparation and execution of each flight operation.

b. Communications Coordinator

It is the responsibility of the Communications Coordinator to commit and control the operational communications equipment and personnel within the SFOF and the equipment within the Space Flight Operations Complex during the preparation and execution of each flight operation.

c. Display Group

It is the function of this group to display operational and technical information for mission and operations control and evaluation.

d. Video Processing Group

It is the function of this group to process the spacecraft video data into a form suitable for analysis.

e. SFOF Support Group

This group will supply operational, maintenance, clerical, and other general support as required for the operation.

5. DSIF Operations Manager

It is the responsibility of the DSIF Operations Manager to direct the operation of the DSIF and to commit and control DSIF personnel and equipment at each station during the preparation and execution of each flight operation.

a. DSIF Net Control

It is the function of this group to be the direct line of contact with the DSIF stations. DSIF Net Control will supply the stations with operational requirements and status and will inform the DSIF Operations Manager of station status.

b. DSIF Advisors

It is the responsibility of the DSIF Advisors to keep the DSIF Operations Manager informed of the current state of the DSIF and to advise future courses of action.

c. DSIF Station Managers

It is the responsibility of the DSIF Station Manager to direct the operation of the DSIF station to which he is assigned, and to control the functions of the personnel and equipment of his station.

6. Technical Analysis Groups

Each of the technical analysis groups (FPAC, SPAC, and SSAC) is headed by a Technical Director who is responsible for integrating, directing, and coordinating the preflight, flight, and postflight activities of his group and who will support the SFOD in the planning and conduct of Surveyor space flight operations. It is the responsibility of these groups to assist in defining the standard mission, to recommend courses of action that will provide optimum value from the mission during nonstandard situations, and to perform the intra- and intergroup technical liaison required to achieve these objectives.

a. Flight Path Analysis and Command (FPAC) Group

It is the responsibility of this group to use the tracking and telemetry data to obtain the best estimate of the actual trajectory of the spacecraft and, supported by the DSIF, to interpret the tracking data supplied by the tracking stations. Additionally, it is the responsibility of this group to determine the spacecraft commands affecting the flight path by utilizing, to the degree required, the support of the SPAC group and the SSAC group. FPAC will consist of:

1) Computing Support Group

2) Trajectory Group

3) Tracking Data Analysis Group

4) Orbit Determination Group

5) Maneuver Analysis Group

b. Spacecraft Performance Analysis and Command (SPAC) Group

It is the responsibility of this group to determine the spacecraft performance and to determine commands to the spacecraft as required by the engineering behavior and performance of the spacecraft. SPAC will include:

1) Performance Analysis Group

2) Engineering Computer Program Operations Group

3) Command Preparation Group

c. Space Science Analysis and Command (SSAC) Group

It is the responsibility of this group to control the flow of, and the mathematical operations performed on the data related to the scientific experiments during the interval between its receipt by the DSIF and its transmission to the appropriate scientists. Additionally, it is the responsibility of this group to determine those commands to the spacecraft pertaining to the scientific experiments. This group will consist of:

1) Operations Engineer

2) Operations Scientist

3) SFO Coordinator

4) Television Evaluation Team Chairman

5) TV Performance Analysis and Command Group

6) Television Science Analysis and Command Group

7) Touchdown Science Evaluation Team

# SECTION II

# OPERATIONAL FACILITIES

## A. GENERAL

This section describes that portion of the Space Flight Operations Complex (SFOC) that will be used by the Surveyor P-42 Mission. The facilities at the Air Force Eastern Test Range (AFETR), the facilities of the Deep Space Instrumentation Facility (DSIF), the Space Flight Operations Facility (SFOF), and the communications between these facilities are described.

## B. AIR FORCE EASTERN TEST RANGE

The support for the Surveyor P-42 Mission required of AFETR is fully described in the AFETR Program Requirements Document (PRD) No. 3400. The facilities that will be used by AFETR in support of Surveyor P-42 are described in the AFETR Program Support Plan (PSP) No. 3400.

Detailed countdown information will be forwarded to Pasadena from the JPL/HAC Operations Center at AFETR during the prelaunch countdown. Additionally, event information from launch through separation will be supplied by AFETR. Details regarding the handling of this information at AFETR and within the JPL/HAC Operations Center at AFETR will be found in the Surveyor Assembly and Operations Plan.

After launch, extensive use of the tracking and telemetry facilities at AFETR will be made in support of the mission. Those requirements are described in the following paragraphs. C-band tracking data will be obtained from the launch vehicle by means of the facilities shown in Figure II-1. Trajectory and prediction data will be generated from the raw data and forwarded in near-real time to the JPL Operations Center at AFETR for relay to the SFOF in Pasadena, California. S-band and VHF telemetry data will be transferred from AFETR to the SFOF in real time as shown in Figure II-2; recorded S-band and VHF telemetry data will be forwarded to the JPL/HAC Operations Center at AFETR.

### 1. Tracking Data Requirements

There are three requirements for near-real time data during the postinjection phases of the direct ascent trajectory:

a. It is required that AFETR obtain an initial estimate of the spacecraft injection conditions which will be forwarded, by AFETR, to the JPL/ HAC Operations Center at AFETR in real time for relay to the SFOF.

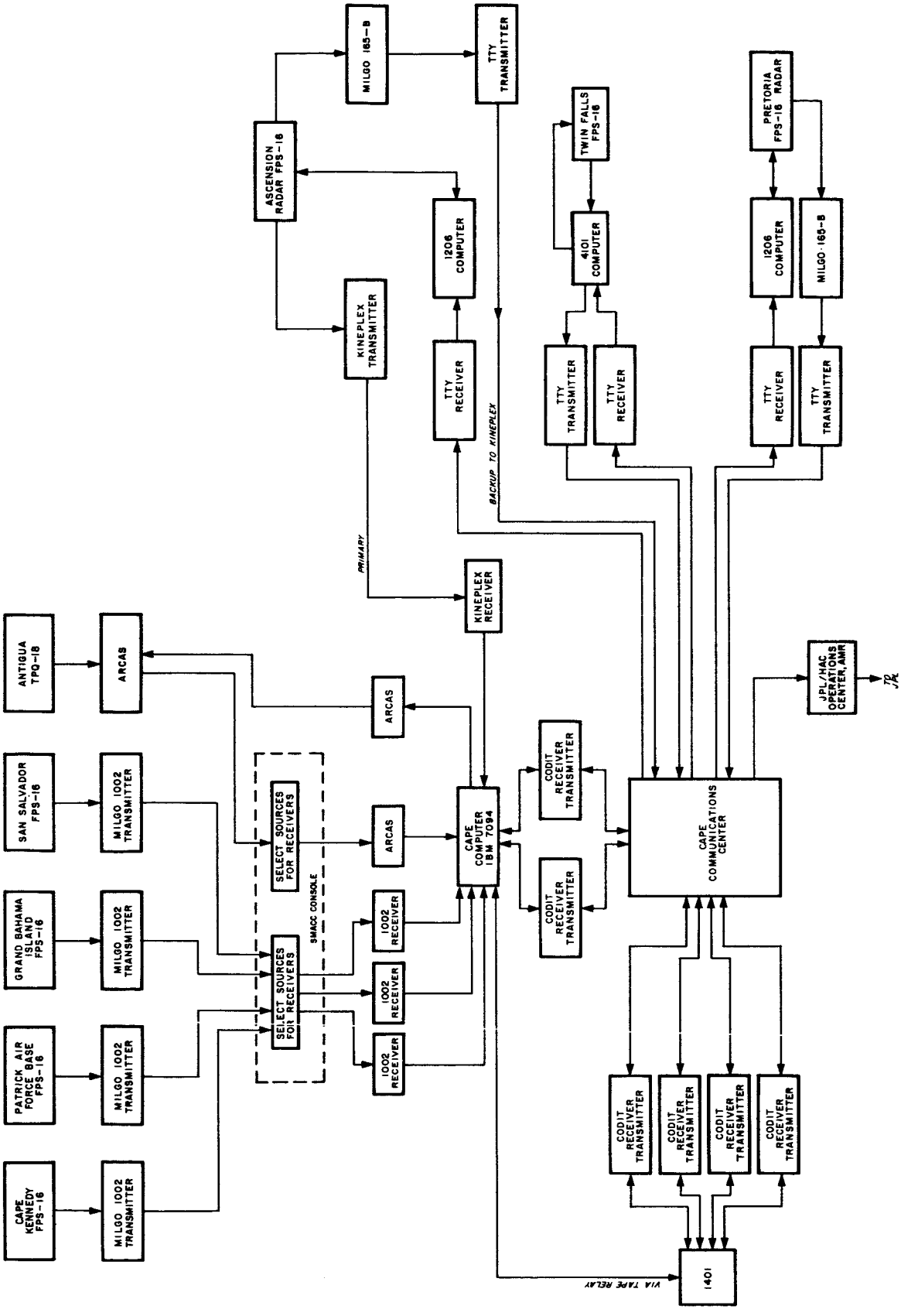
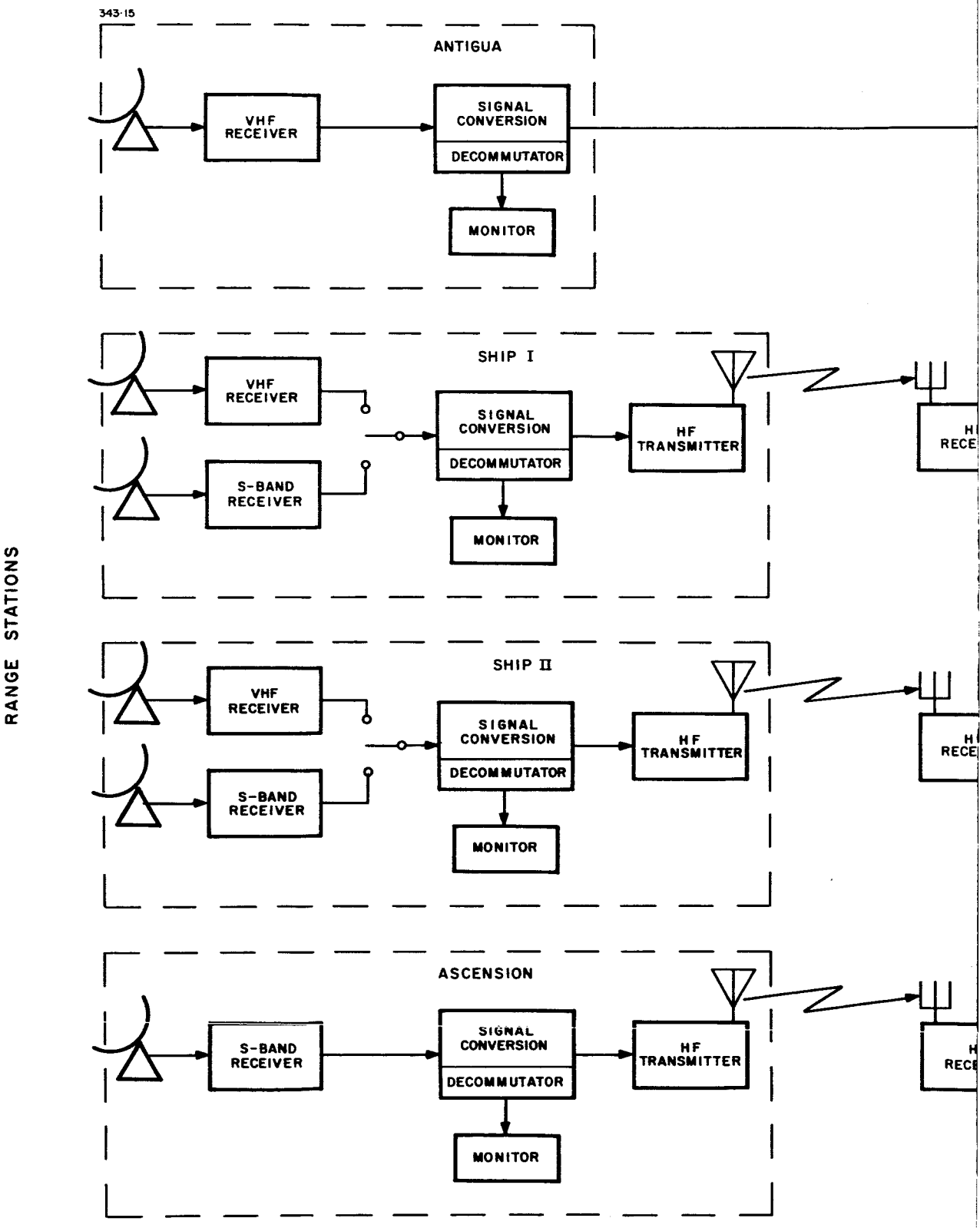



FIGURE II-1. TRACKING FACILITIES SUPPORTING SURVEYOR AT AFETR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MONITOR
SHIP II
VHF RECEIVER
S-BAND RECEIVER
SIGNAL CONVERSION
DECOMMUTATOR
HF TRANSMITTER
MONITOR
ASCENSION
S-BAND RECEIVER
SIGNAL CONVERSION
DECOMMUTATOR
HF TRANSMITTER
MONITOR
RANGE STATIONS

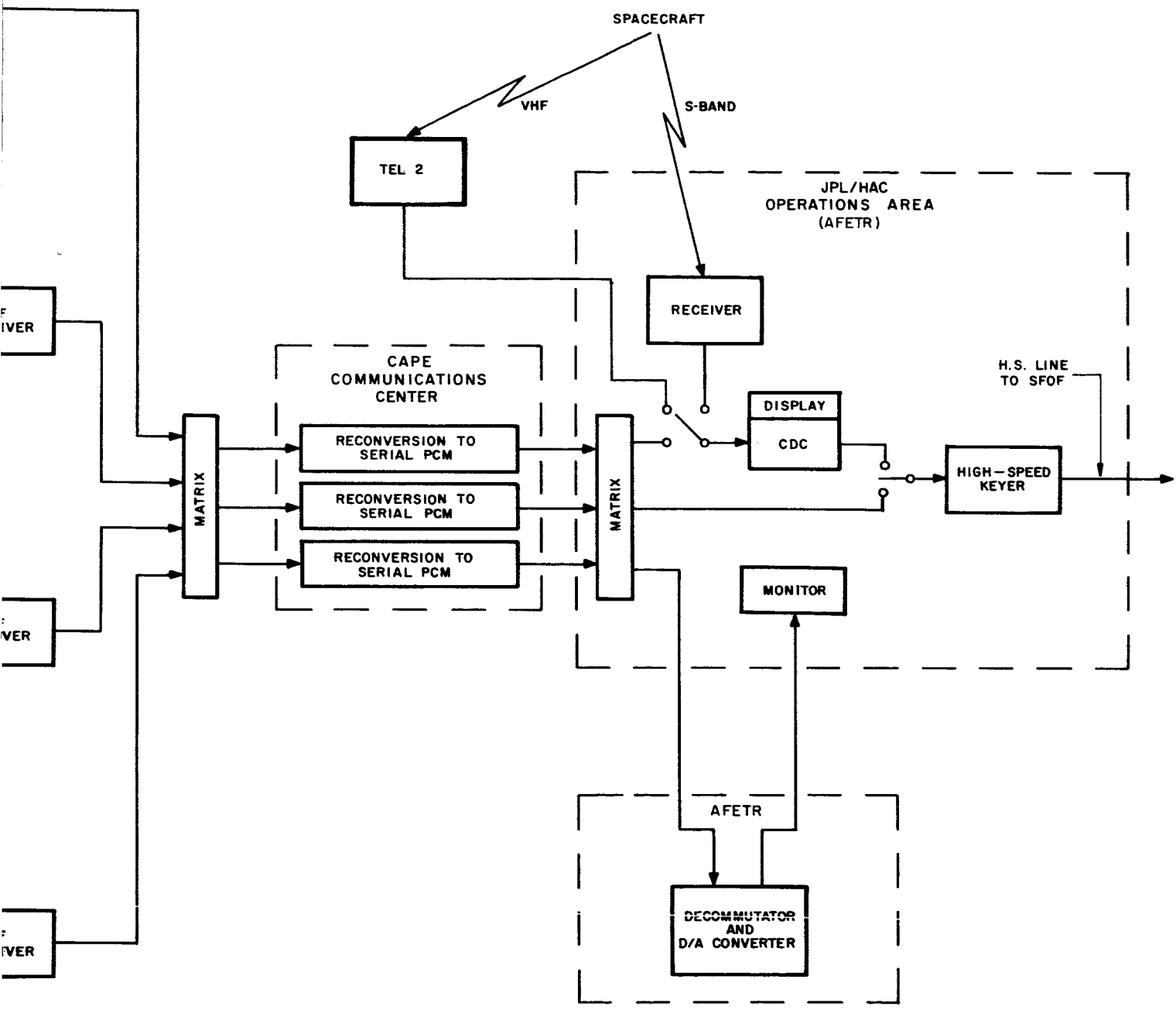



FIGURE II-2. AFETR/SURVEYOR REAL TIME TELEMETRY DATA SYSTEM

b. Initial acquisition data for the DSIF is required from AFETR. The raw tracking data obtained from downrange stations will be forwarded to the computing center located in the Impact Predictor Building (IPP) at AFETR. This data, in conjunction with pertinent telemetry data, will be used to determine the trajectory of the spacecraft. Table II-I shows the format for all computed data furnished by AFETR to JPL/HAC.

The acquisition data shown in Table II-I will be computed and forwarded to the JPL/HAC Operations Center at AFETR for relay to the SFOF in Pasadena and thence to the DSIF stations.

c. Semi-raw tracking data will be transferred from the Impact Predictor Building to the JPL/HAC Operations Center AFETR for relay to the SFOF. The format of this data is shown in Table II-II.

2. Telemetry Requirements

a. Launch vehicle and spacecraft telemetry obtained through the Centaur VHF link, and spacecraft telemetry obtained through the spacecraft S-band link, are recorded at the AFETR stations. The recorded information will be forwarded to JPL/HAC at AFETR in nonreal time.

b. Launch vehicle and spacecraft event information is obtained at AFETR stations and is transmitted by voice lines in real time to the JPL/HAC Operations Center at AFETR for relay to the SFOF.

c. Spacecraft telemetry obtained via the VHF link will be transmitted in real time to the JPL/HAC Operations Center at AFETR for relay to the SFOF from approximately five minutes before injection until immediately prior to spacecraft/Centaur electrical disconnect. Thereafter, spacecraft telemetry obtained via the S-band link will be transmitted in real time to JPL/HAC. Additionally, the telemetry may be monitored at the AFETR stations, and the performance of the spacecraft reported to JPL/HAC in real time by voice line.

TABLE II-I. AFETR TTY FORMAT FOR COMPUTED DATA

A. First Message

Actual launch time and azimuth.

LIFTOFF DAY XXX HMS XX XX XX.X GMT AZL XXX.XX

B. Second Message

Orbital elements and injection conditions.

1. TTY Format

ELEMENTS AND INJECTION COND OF ACTUAL TRANSFER

ORBIT YYY.YY

H M S XX XX XX.X L PLUS TIME XXXXX. ALT XXX.XX

SMA XXXXX.X ECC X.XXXXXX INC XXX.XXX C3 XX.XX

LAN XXX.XXX APF XXX.XXX TA XXX.XXX

R XXXXX. LAT XX.XXX LON XXX.XXX VE XX.XXX

PTE XX.XXX AZE XXX.XXX

2. Nomenclature

| | |
|---|---|
| GMT (HMS) | Time of launch |
| AZL | Azimuth of launch |
| YYY.YY | Data source of computations. The number before the decimal is the station ID; the number after the decimal indicates the number of the transmission. (AFETR is to use numbers from 01-09; JPL is to use numbers from 10-99.) |
| HMS | Epoch - Universal Time (Hours, Minutes, and Seconds); time at which osculating conic is calculated |
| L PLUS TIME | Epoch, seconds after liftoff |
| ALT | Distance above Earth's surface in kilometers |

(This table continued on next page.)

TABLE II-I. (CONT'D)

2. Nomenclature (Cont'd)

| | |
|---|---|
| SMA | Semimajor axis of conic section. Negative for a hyperbola. (kilometers) |
| ECC | Eccentricity of conic section |
| INC | Inclination - Angle between the orbital plane and the Earth's (instantaneous) equator. Degrees, between 0° (zero) and 360° |
| C3 | Twice the total energy per unit mass or vis viva in $km^2/sec^2$. |
| LAN | Right ascension of the ascending node. Degrees, from 0° (zero) to 360°. Measured from the vernal equinox of date in the instantaneous equatorial plane. |
| APF | Argument of Perigee. Angle, in the orbital plane, eastward from the ascending node to the perigee point. Degrees, from 0° (zero) to 360°. |
| TA | True anomaly at epoch. The angle measured from perigee to the spacecraft. Measured eastward in degrees. |
| R | Injection radius in kilometers |
| LAT | Injection latitude in degrees |
| LON | Injection longitude in degrees |
| VE | Inertial velocity in km/sec |
| PTE | Inertial path angle at injection |
| AZE | Injection azimuth in degrees |

(This table continued on next page.)

TABLE II-I. (CONT'D)

C. Third Message

Acquisition information for DSIF.

1. TTY Format

JPL LOOK ANGLES FROM ACTUAL TRANSFER ORBIT

XMITTER REF FREQ XXXXXX XPONDER FREQ XXXXXX

H M S XX XX XX.X RANGE XXXXX.XXX

| H M S | HA | DEC | D1.51 | D2.51 | XA.51 | ID |
|---|---|---|---|---|---|---|
| XXXXXX | XXX.X | XXX.X | XXXXXX | XXXXXX | XXXXXX | LMPQR |
| XXXXXX | XXX.X | XXX.X | XXXXXX | XXXXXX | XXXXXX | LMPQR |
| XXXXXX | XXX.X | XXX.X | XXXXXX | XXXXXX | XXXXXX | LMPQR |

H M S XX XX XX.X RANGE XXXXX.XXX

END OF LOOK ANGLES FROM ACTUAL TRANSFER ORBIT

2. Nomenclature

| | |
|---|---|
| HMS | Hours, Minutes, Seconds |
| HA | Hour angle, nearest one-tenth degree |
| DEC | Declination, nearest one-tenth degree |
| D1.51 | One-way doppler detector output frequency for Station 51, cps |
| D2.51 | Two-way doppler detector output frequency for Station 51, cps |
| XA.51 | Transmitter VCO frequency for spacecraft zero static phase error for Station 51, cps |
| ID | As listed below: |
| | LM - Orbit number, from 01 to 99 |
| | PQR - Day of year |

TABLE II-II. AFETR SEMI-RAW TRACKING DATA FORMAT FOR TTY TRANSMISSION

| CHARACTER TRANSMITTED | INFORMATION |
|---|---|
| 1 | Carriage Return |
| 2 | Line Feed |
| 3 | Figure Shift |
| 4 | Data Type |
| 5 | Station ID |
| 6 | Station ID |
| 7 | Radar Type |
| 8 | On Track - Code 2 |
| 9 | Time - H 20, 19 |
| 10 | Time - H 18, 17, 16, 15 |
| 11 | Time - M 14, 13, 12 |
| 12 | Time - M 11, 10, 9, 8 |
| 13 | Time - S 7, 6, 5 |
| 14 | Time - S 4, 3, 2, 1 |
| 15 | Az 21, 20, 19 |
| 16 | Az 18, 17, 16 |
| 17 | Az 15, 14, 13 |
| 18 | Az 12, 11, 10 |
| 19 | Az 9, 8, 7 |
| 20 | Az 6, 5, 4 |
| 21 | Az 3, 2, 1 |
| 22 | El 21, 20, 19 |
| 23 | El 18, 17, 16 |
| 24 | El 15, 14, 13 |
| 25 | El 12, 11, 10 |
| 26 | El 9, 8, 7 |
| 27 | El 6, 5, 4 |
| 28 | El 3, 2, 1 |
| 29 | R 27, 26, 25 |
| 30 | R 24, 23, 22 |
| 31 | R 21, 20, 19 |
| 32 | R 18, 17, 16 |
| 33 | R 15, 14, 13 |
| 34 | R 12, 11, 10 |
| 35 | R 9, 8, 7 |
| 36 | R 6, 5, 4 |
| 37 | R 3, 2, 1 |
| 38 | End of Sample |

See Legend on next page.

## LEGEND

1. Character 4, Data Type:

   2 - Real Time
   3 - Simulated Data
   7 - Last Sample

2. Characters 5 and 6, Station ID:

| | |
|---|---|
| Bermuda | 70 |
| San Salvador | 72 |
| Grand Turk | 73 |
| Antigua | 74 |
| Ascension | 75 |
| Pretoria | 76 |
| Twin Falls | 77 |
| ARIS I | 78 |
| ARIS II | 79 |

3. Character 8, On Track:

   Off Track - 0
   On Track - 2

4. Characters 9 - 14, Time:

   20-Bit Binary Coded Decimal Time Code Character

5. Characters 15 - 21, Azimuth Data in Binary Code:

   Most Significant Digit - Bit 20 - 180 Degrees
   Least Significant Digit - Bit 1 - 0.000343 Degrees

6. Characters 22 - 28, Elevation Data in Binary Code:

   Most Significant Digit - Bit 20 - 180 Degrees
   Least Significant Digit - Bit 1 - 0.000343 Degrees

7. Characters 29 - 37, Range Data in Binary Code:

   Most Significant Digit - $2^{26}$ - 67,108,864 Yards
   Least Significant Digit - $2^{0}$ - 1 Yard

8. Character 38, End of Sample:

   End of Sample - Oblique Stroke

## SECTION II, C. DEEP SPACE INSTRUMENTATION FACILITY

## SECTION II, D. SPACE FLIGHT OPERATIONS FACILITY

### DEEP SPACE NETWORK

The function of the Deep Space Network (DSN) for the Surveyor P-42 Mission is to provide those facilities necessary to meet the space flight operations requirements of the Surveyor Project. The DSN includes the Deep Space Instrumentation Facility (DSIF), DSN Ground Communications System, and the Space Flight Operations Facility (SFOF).

APPROVED: _____

M. S. Johnson
DSN Manager, Surveyor

## C. DEEP SPACE INSTRUMENTATION FACILITY (DSIF)

The function of the DSIF is to obtain angular position, doppler, telemetry, and video data from the Surveyor spacecraft during the postinjection phase of the mission. Additionally, the DSIF will transmit commands to the spacecraft in accordance with the procedures outlined in Section VI of the Surveyor Tracking Instruction Manual (TIM), EPD- (to be published).

Data obtained by the DSIF is transmitted to the SFOF in real time or near-real time by teletype and high-speed data circuits, and by wide-band microwave channel (from Goldstone only). The same data is recorded on magnetic tape at the DSIF station and dispatched to JPL by airmail.

### 1. DSIF Coverage

Three DSIF stations are committed to meet the requirements placed on the DSIF by the Surveyor Project; these are designated the prime stations. They are Goldstone Pioneer (DSIF 11), Johannesburg (DSIF 51), and Canberra (DSIF 42). The DSIF will provide coverage as specified in Table II-III.

The full Goldstone Duplicate Standard (GSDS) S-band system will be used at Goldstone Pioneer (DSIF 11), Canberra (DSIF 42), and for the DSIF 51 acquisition aid. The L-to-S band (L/S) conversion system will be used at Johannesburg (DSIF 51). The parameters and capabilities of the DSIF stations are given in Table II-IV. Block diagrams of the stations are presented in Figures II-3 through II-5.

Acquisition and prediction information required by the DSIF is given in Table II-V. The tracking data to be supplied by the DSIF to the SFOF for orbit determination is shown in Table II-VI. Ground station tracking modes are listed in Table II-VII. The data condition codes used by the DSIF stations are listed in Table II-VIII.

Station reports, as detailed in Table II-IX, will be periodically transmitted by each DSIF station to the SFOF. These reports will be distributed as required within the SFOF.

TABLE II-III. DSIF COVERAGE

| PHASE | DSIF COVERAGE |
|---|---|
| Transit | 24-hour/Earth day |
| If landing is achieved | |
| 1. First lunar day and night | 24-hour/Earth day |
| 2. Second lunar day* | a. 24-hour/Earth day for first three Earth days |
| | b. 24-hour/Earth day for last two Earth days |
| | c. One ten-hour pass/Earth day between a. and b. above |
| 3. Succeeding lunar days and nights* | a. 24-hour/Earth day for first three Earth days |
| | b. 24-hour/Earth day for last two Earth days |
| | c. One ten-hour pass/Earth day between a. and b. above |
| If no landing is achieved | a. 24-hour/Earth day for not more than three Earth days after encounter |
| | b. 8-hour/Earth day for additional 10 Earth days |

* 24-hour/Earth day coverage required whenever valuable data can be provided by spacecraft instruments.

TABLE II-IV. DSIF CAPABILITIES FOR SURVEYOR

| | | | | |
|---|---|---|---|---|
| 1. | STATION NAME | Goldstone Pioneer GSDS S-Band | Canberra GSDS S-Band | Johannesburg L/S Conversion |
| 2. | STATION ID | DSIF 11 | DSIF 42 | DSIF 51 |
| 3. | RECEIVER CAPABILITY | One | One | One |
| 4. | ANTENNA | 85' Parabolic | 85' Parabolic | 85' Parabolic |
| 5. | MOUNT | Polar (HA-Dec) | Polar (HA-Dec) | Polar (HA-Dec) |
| 6. | MAX. ANGULAR RATE (BOTH AXES) | 0.7 Deg/Sec | 0.7 Deg/Sec | 0.7 Deg/Sec |
| 7. | FREQUENCY<br>RECEIVING (mc)<br>TRANSMITTING (mc) | <br>2295<br>2115 | <br>2295<br>2115 | <br>2295<br>2115 |
| 8. | ANTENNA GAIN<br>RECEIVING<br><br>TRANSMITTING | <br>53.0 db $^{+1.0}_{-0.5}$<br>51.0 db $^{+1.0}_{-0.5}$ | <br>53.0 db $^{+1.0}_{-0.5}$<br>51.0 db $^{+1.0}_{-0.5}$ | <br>53.0 db $^{+1.0}_{-0.5}$<br>51.0 db $^{+1.0}_{-0.5}$ |
| 9. | ANTENNA BEAMWIDTH | 0.4 deg | 0.4 deg | 0.4 deg. |
| 10. | TYPICAL SYSTEM TEMP.<br>WITH PARAMP<br>WITH MASER | <br>270°K +50<br>55°K $\pm$10 | <br>270°K +50<br>55°K $\pm$10 | <br>270°K +50<br>55°K $\pm$10 |
| 11. | TRANSMITTER POWER | 10 kw | 10 kw | 10 kw |
| 12. | DATA TRANSMISSION (TTY)<br>a) ANGLES<br>b) DOPPLER<br>c) TELEMETRY | <br>Near-Real Time<br>Near-Real Time<br>Real Time | <br>Near-Real Time<br>Near-Real Time<br>Real Time | <br>Near-Real Time<br>Near-Real Time<br>Real Time |
| 13. | CDC CAPABILITY | Yes | Yes | Yes |
| 14. | DATA PACK AIR SHIPMENT TIME TO JPL | 1 Day | 7 Days | 5 Days |

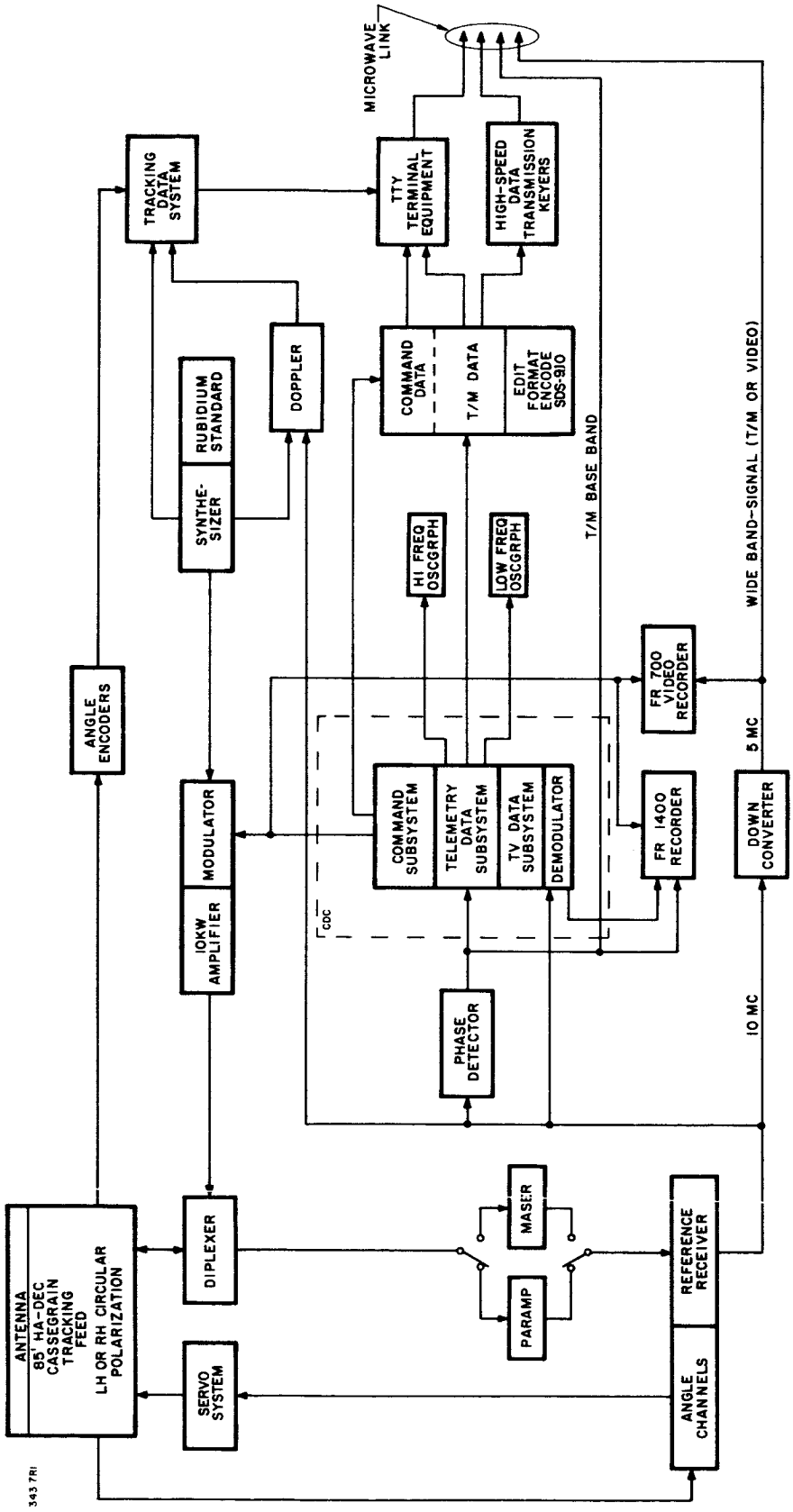



FIGURE II-3. GOLDSTONE PIONEER STATION (DSIF 11) S-BAND

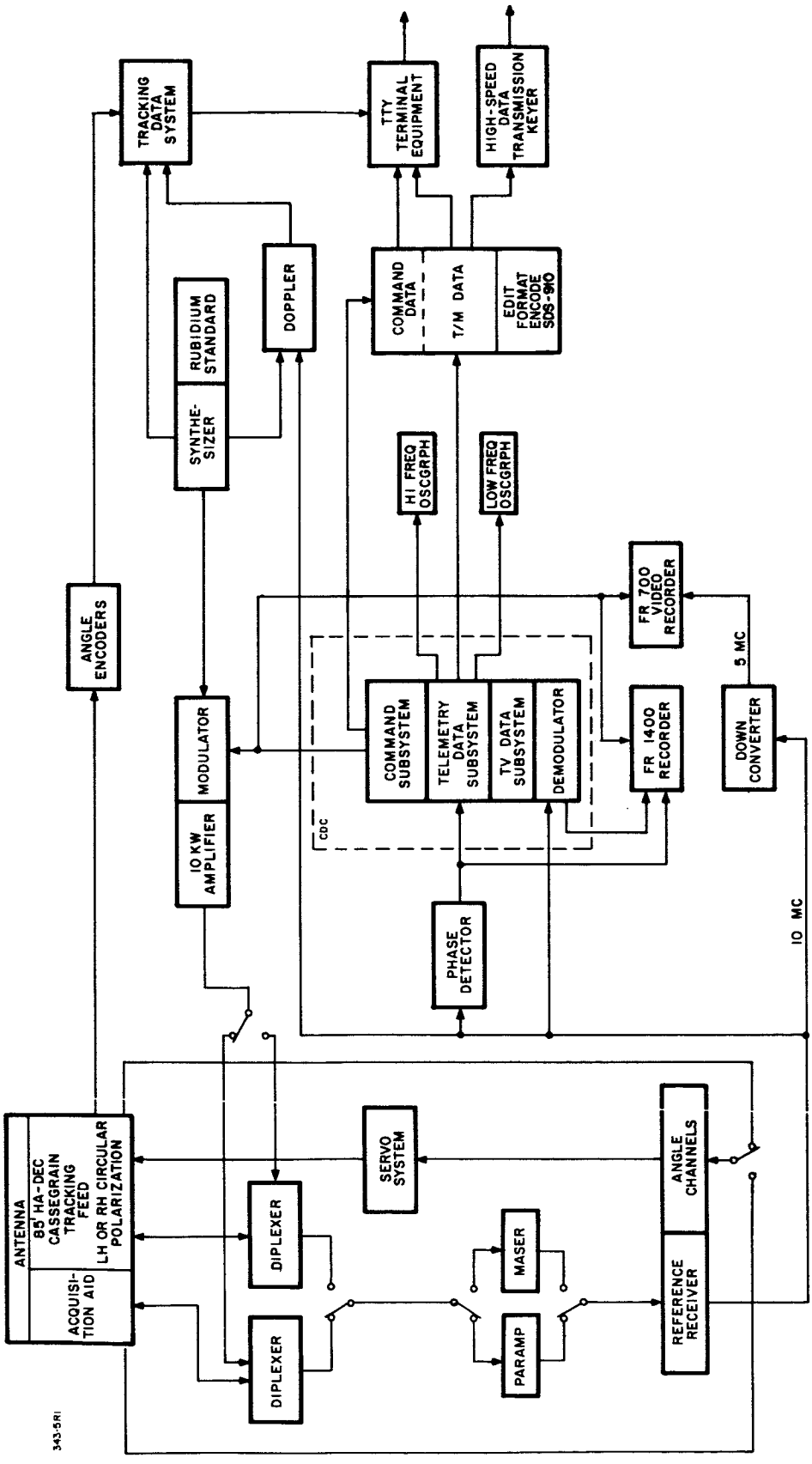



FIGURE II-4. JOHANNESBURG STATION (DSIF 51) L/S CONVERSION

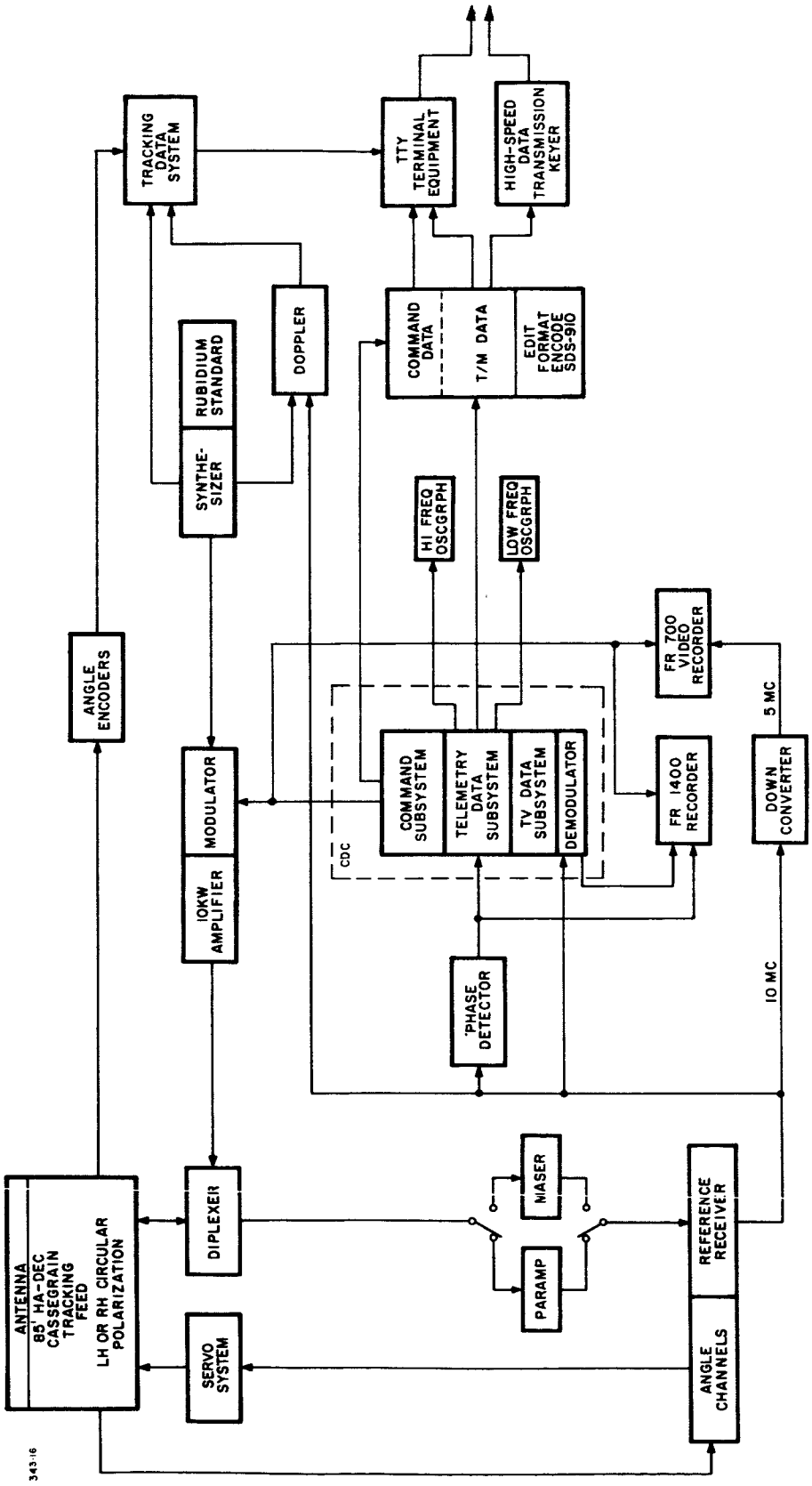



FIGURE II-5. CANBERRA STATION (DSIF 42) S-BAND

TABLE II-V. ACQUISITION AND PREDICTION INFORMATION FOR THE DSIF

A. Format

1. Calculated at JPL

JPL LOOK ANGLES (Station Name)

JPL PREDICTS (Transmission Number)

XMITTER REF FREQ XXXXXX XPONDER FREQ XXXXXX

H M S XX XX XX.X RANGE XXXXX.XXX

| H M S | HA | DEC | D1.AB | D2.AB | XA.AB | ID |
|---|---|---|---|---|---|---|
| XXXXXX | XXX.X | XXX.X | XXXXXX | XXXXXX | XXXXXX | XXX |
| XXXXXX | XXX.X | XXX.X | XXXXXX | XXXXXX | XXXXXX | XXX |
| XXXXXX | XXX.X | XXX.X | XXXXXX | XXXXXX | XXXXXX | XXX |

2. Calculated at AFETR

See Table II-I.

B. Nomenclature

| | |
|---|---|
| HMS | Hours, Minutes, Seconds |
| HA | Hour Angle, nearest one-tenth degree |
| DEC | Declination, nearest one-tenth degree |
| D1.AB | One-way doppler detector output frequency for Station B, Zone A, cps |
| D2.AB | Two-way doppler detector output frequency for Station B, Zone A, cps |
| XA.AB | Transmitter VCO frequency for spacecraft zero static phase error for Station B, Zone A, cps |
| ID | Day of year |

(This table continued on next page.)

TABLE II-V. (CONT'D)

C. Sample Rate

The sample rate for the earlier part of the initial view period will be one sample per 2 minutes; for the remainder of the view period the rate will be one sample per 5 minutes. For all other view periods, one sample per 5 minutes will be supplied for each pass. The data will be updated each day.

D. Availability of Data

| TIME | ORIGIN | FOR DSIF | SAMPLE RATE AND AMOUNT |
|---|---|---|---|

(To be supplied at a later date.)

TABLE II-VI. TRACKING DATA SUPPLIED BY THE DSIF

A. The tracking data from DSIF 11, 42, and 51 will contain time (GMT), a data condition code, hour angle (decimal degrees, nearest two-thousandth), declination angle (decimal degrees, nearest two-thousandth), doppler cycle count (to nearest cycle), and day of year. The format will be:

| DSIF STATION | FORMAT I.D. | SPACE-CRAFT I.D. | DATA CONDITION CODE | GMT | DAY OF YEAR | DOPPLER COUNT | HOUR * ANGLE (deg) | DECLIN-ATION * ANGLE (deg) |
|---|---|---|---|---|---|---|---|---|
| XX | XX | XX | XXXX | XXXXXX | XXX | XXXXXXXXXX | XXXXXX | XXXXXX |

B. Data sampling and doppler counting times:

| DSIF STATION | TIME INTERVAL | SAMPLING INTERVAL | DOPPLER COUNTING TIME |
|---|---|---|---|
| 11 and 42 | L to Lunar Touch-down -1 hr | 1 per min | 60 sec nondestructive |
| | Lunar Touchdown -1 hr to Touchdown | 1 per 10 sec | 10 sec nondestructive |
| 51 | L to L +47 min | 1 per 10 sec | 5 sec |
| | L +47 min to Lunar Touchdown | 1 per min | 60 sec nondestructive |

* The angle data from DSIF 11 will not be the result of auto-track operation.

## TABLE II-VII. GROUND STATION TRACKING MODES

This mode description is used to define the station configuration. The code is broken into two parts. The first defines the Transmit/Receive mode and the second the Antenna Feed configuration.

| TRANSMIT/RECEIVE | | FEED | |
|---|---|---|---|
| GM-0 | No receive (transmit only) | 0 | Not Used |
| GM-1 | One-way doppler (receive only) | 1 | Horn feed diplexer combination (receive and transmit up to 10 kw) |
| GM-2 | Two-way, one-station (transmit/receive) | 2 | Tracking feed diplexer combination (receive and transmit up to 200 w) |
| GM-3 | Two-way, two-station non-coherent (receive only) | 3 | Acquisition antenna |
| | | 4 | Dipole (receive and transmit up to 25 w) |
| | | 5 | Horn feed, no diplexer (receive only) |

Example: GM-2-1; transmitting to spacecraft and receiving two-way doppler; horn feed and diplexer.

Note. Telemetry will be available in all receive modes except GM-0.

TABLE II-VIII. DATA CONDITION CODE USED BY DSIF STATIONS

DIGIT NO. 1

Doppler Averaging Time

| Value of Digit | Time |
|---|---|
| 0 | 1 Sec |
| 1 | 5 Sec |
| 2 | 10 Sec |
| 3 | 20 Sec |
| 4 | 30 Sec |
| 5 | 40 Sec |
| 6 | 50 Sec |
| 7 | 60 Sec |
| 8 | Nondestructive |

DIGIT NO. 2

Receiver & Servo Data Condition

| Value of Digit | Data Condition |
|---|---|
| 0 | Good Doppler & Angle Data |
| 1 | Bad Angle Data, Auto Sense |
| 2 | Bad Doppler Data, Auto Sense |
| 3 | Bad Doppler & Angle Data, Auto Sense |
| 4 | Not Used |
| 5 | Bad Angle Data, Manual Switch |
| 6 | Bad Doppler Data, Manual Switch |
| 7 | Bad Doppler & Angle Data, Manual Switches |

DIGIT NO. 3

Doppler Mode

| Value of Digit | Counter Recorder | Doppler Mode |
|---|---|---|
| 0 | 1 | Two-Way ($C_2$) |
| 1 | 1 | One-Way ($C_1$) |
| 2 | 1 | Pseudo Two-Way ($C_3$) |
| 4 | 2 | Two-Way ($C_2$) |
| 5 | 2 | One-Way ($C_1$) |
| 6 | 2 | Pseudo Two-Way ($C_3$) |

DIGIT NO. 4

Atomic Frequency Standard

| Value of Digit | Data Condition |
|---|---|
| 0 | In Lock |
| 1 | Out of Lock |
| 2 | Not Applicable |

TABLE II-IX. DSIF STATION TRACKING REPORT

During a tracking period, station reports will be submitted:

1) Every 30 minutes from Launch to Midcourse +1 hour.

2) After Midcourse, on the hour during each station's tracking period.

Voice reports will be given from Touchdown -60 minutes to Touchdown.

During the first 24 hours after Launch, each station report will be identified with Launch-referenced time (e. g., L +60 minutes). The report will contain the following information:

1) Ground station tracking mode (GM) as well as start and/or end time of each mode. (Table II-VII defines the ground modes.)

2) Average signal level in dbm and AGC volts plus any variation about this level; also GMT of the signal level reading.

3) Telemetry channel condition.

4) Equipment failures and times of failures.

5) Time-labeled transmitter VCO frequency in mc/s, measured every 5 minutes during the reporting period.

6) Transmitter power in watts.

7) Time (GMT) of significant events, for example:

   a) Time of acquisition

   b) Time of loss of signal

   c) Time of significant changes in the tracking system, e. g., receiver and servo bandwidth changes

   d) Time of abrupt frequency shifts

   e) Time of changes in signal level corresponding to c) and d) above

Note. Report Items 1 through 6 will be indicated by item number and value. Entries under Report Item 7 will be defined.

## D. SPACE FLIGHT OPERATIONS FACILITY

### 1. General

Control of Space Flight Operations for the Surveyor P-42 Mission will be exercised from the SFOF by the Surveyor Project Office. In addition to providing the capability to exercise this control, the SFOF shall provide the necessary data processing, communications, display, and support capabilities required by the technical groups and the DSIF to perform the analysis, evaluation, and interpretation of spacecraft and/or spacecraft-related data, and to determine and implement the ground control of the spacecraft.

### 2. Control and Analysis Functions in the SFOF

The space flight operations associated with Surveyor will be directed by the Space Flight Operations Director (SFOD) from the SFOF. The SFOD will operate from Mission Control Room No. 1, adjacent to the Operations Area of the SFOF (see Figure II-6).

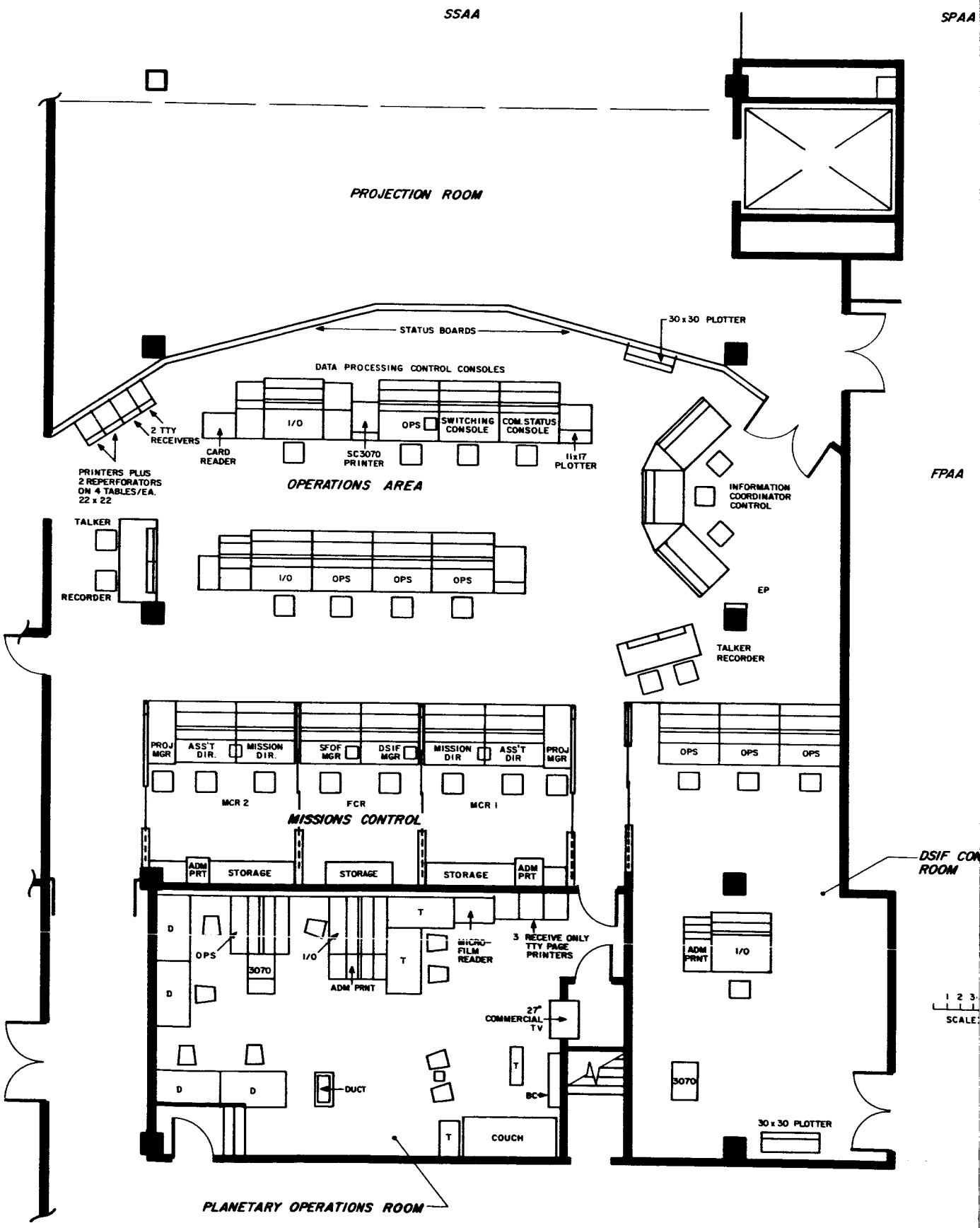
The technical functions that provide the analysis, evaluation, and interpretation of spacecraft and/or spacecraft-derived information for Surveyor mission direction and evaluation are performed in the Flight Path Analysis Area (FPAA), in the Mission Support Area (which comprises the Space Science Analysis Area (SSAA) and the Spacecraft Performance Analysis Area (SPAA)), and in the Spacecraft Television Analysis Area (STAA). Use of the STAA will be shared with the Lunar Orbiter Project. Layout of the SSAA and STAA is shown in Figure II-7. The SPAA is illustrated in Figure II-8, and the FPAA in Figure II-9.

Normally, the technical functions are performed in the three areas just stated. However, the Operations Area may, at the discretion of the SFOD, be used for this purpose during the critical phases of the mission that require close coordination between technical and operational personnel, and between the SFOD and the Project Manager.

In standard operations, all commands to the Surveyor spacecraft will originate in, and be controlled from the SFOF. Approval of the SFOD will be required before any commands or sequences of commands are transmitted from the SFOF and/or DSIF to the spacecraft.

Each technical area of the SFOF will be provided with a remote inquiry station of the Data Processing System, including a remote I/O console with an associated administrative printer and card reader to permit direct usage of the Data Processing System from the technical areas. An SC 3070 high-speed printer will also be provided as well as an 11" x 17" Dymec plotter and a 30" x 30" Milgo plotter to display the output of the Data Processing System. An appropriate number of receive-only teletype page printers and reperforators will be provided in each technical area to permit display of the data received in the SFOF directly from the teletype lines.

The Television Ground Data Handling System, with equipment on the second floor of the SFOF, will provide the capability for recording spacecraft television data, and will display this data in real time in the SSAA.


SSAA
SPAA
PROJECTION ROOM
STATUS BOARDS
30 x 30 PLOTTER
DATA PROCESSING CONTROL CONSOLES
2 TTY RECEIVERS
I/O
OPS
SWITCHING CONSOLE
COM. STATUS CONSOLE
CARD READER
SC3070 PRINTER
11x17 PLOTTER
PRINTERS PLUS 2 REPERFORATORS ON 4 TABLES/EA. 22 x 22
OPERATIONS AREA
FPAA
INFORMATION COORDINATOR CONTROL
TALKER
RECORDER
I/O
OPS
OPS
OPS
EP
TALKER RECORDER
PROJ MGR
ASS'T DIR.
MISSION DIR.
SFOF MGR
DSIF MGR
MISSION DIR
ASS'T DIR
PROJ MGR
MCR 2
FCR
MCR 1
MISSIONS CONTROL
OPS
OPS
OPS
DSIF CONTROL ROOM
ADM PRT
STORAGE
STORAGE
STORAGE
ADM PRT
D
D
OPS
3070
I/O
ADM PRNT
T
T
MICRO-FILM READER
3 RECEIVE ONLY TTY PAGE PRINTERS
ADM PRNT
I/O
27" COMMERCIAL TV
1 2 3
SCALE
D
D
DUCT
T
BC
3070
T
COUCH
30 x 30 PLOTTER
PLANETARY OPERATIONS ROOM

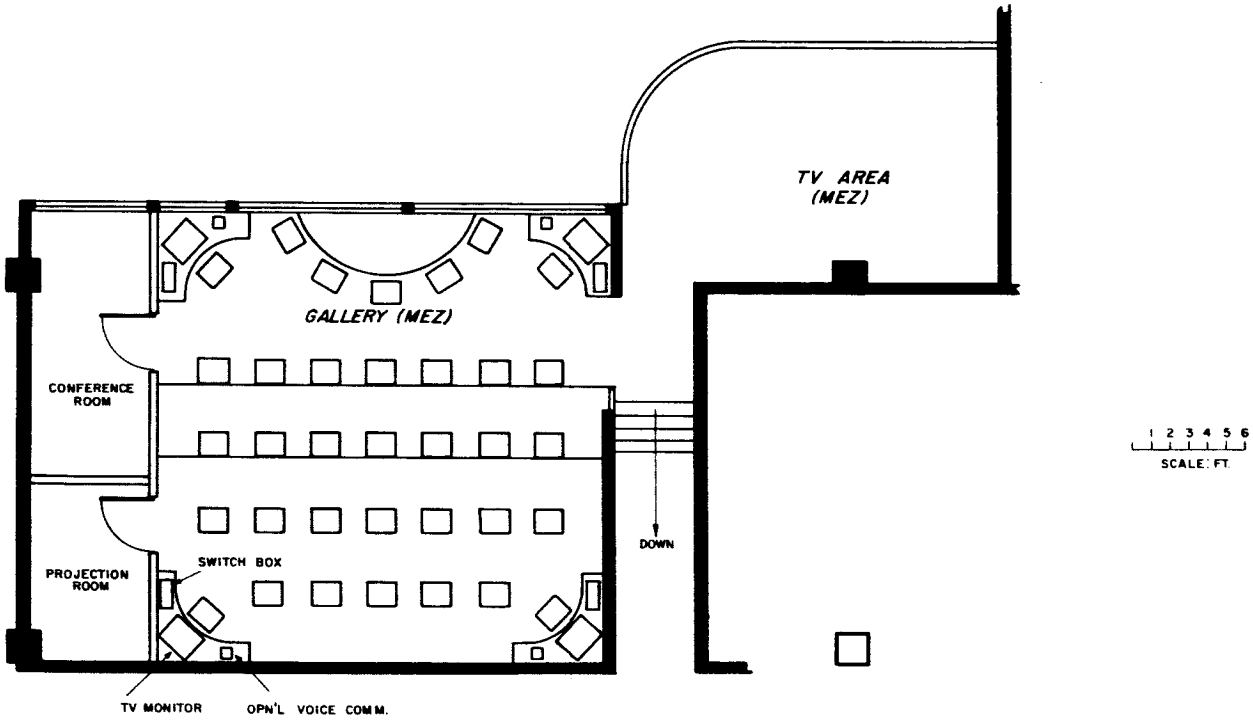



FIGURE II-6. OPERATIONS AREA LAYOUT

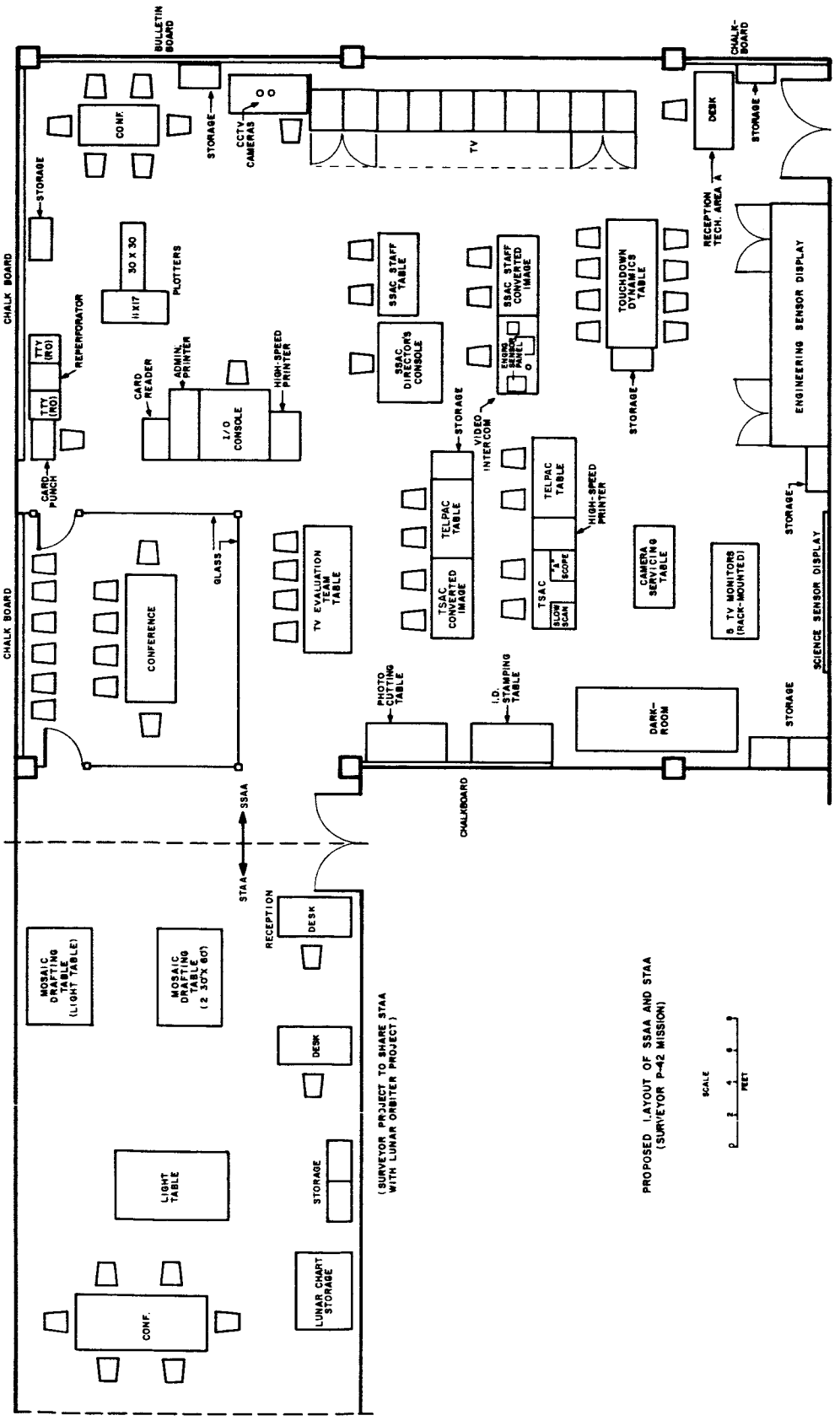



FIGURE II-7. SPACE SCIENCE ANALYSIS AREA LAYOUT

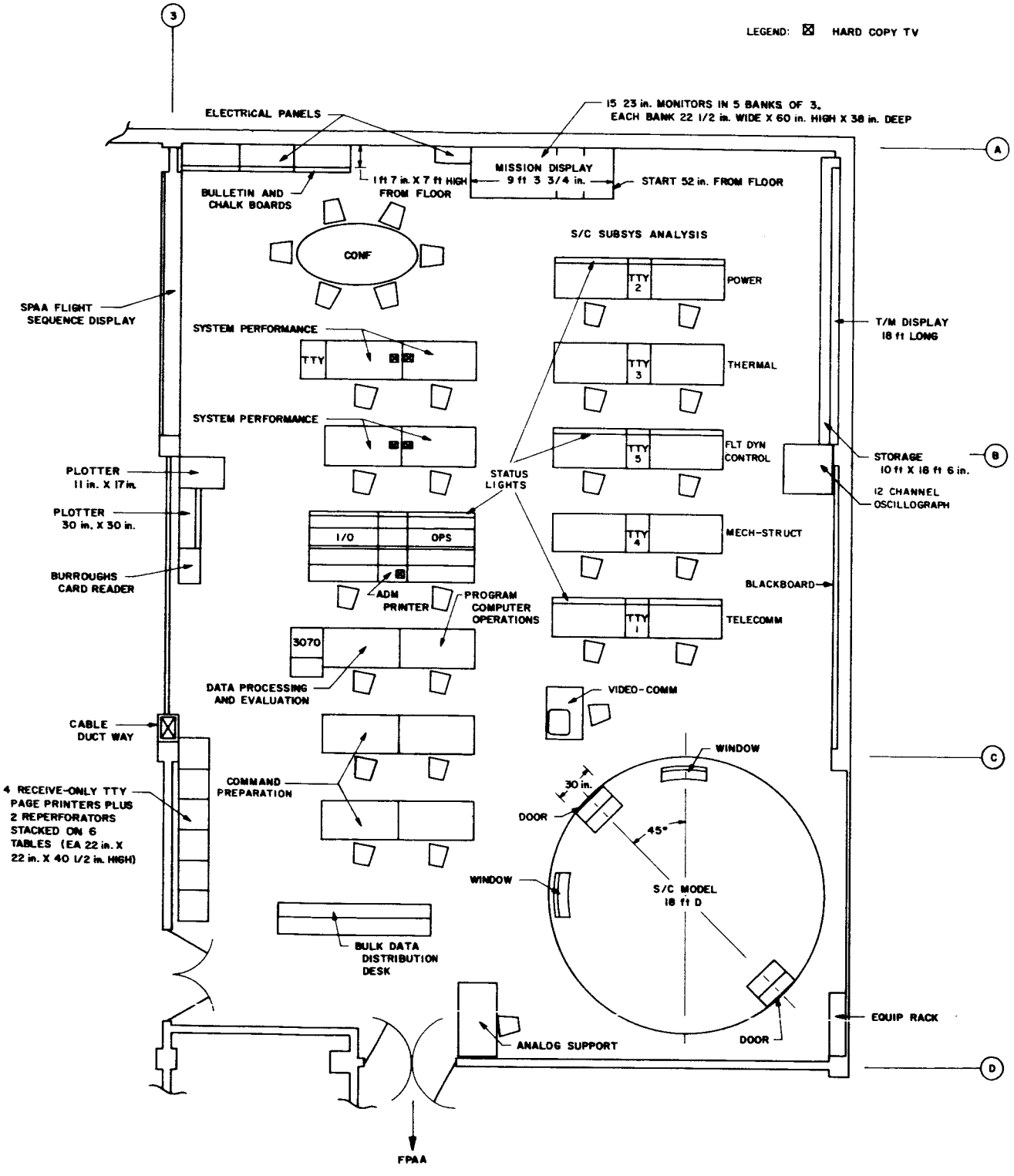



FIGURE II-8. SPACECRAFT PERFORMANCE ANALYSIS AREA LAYOUT

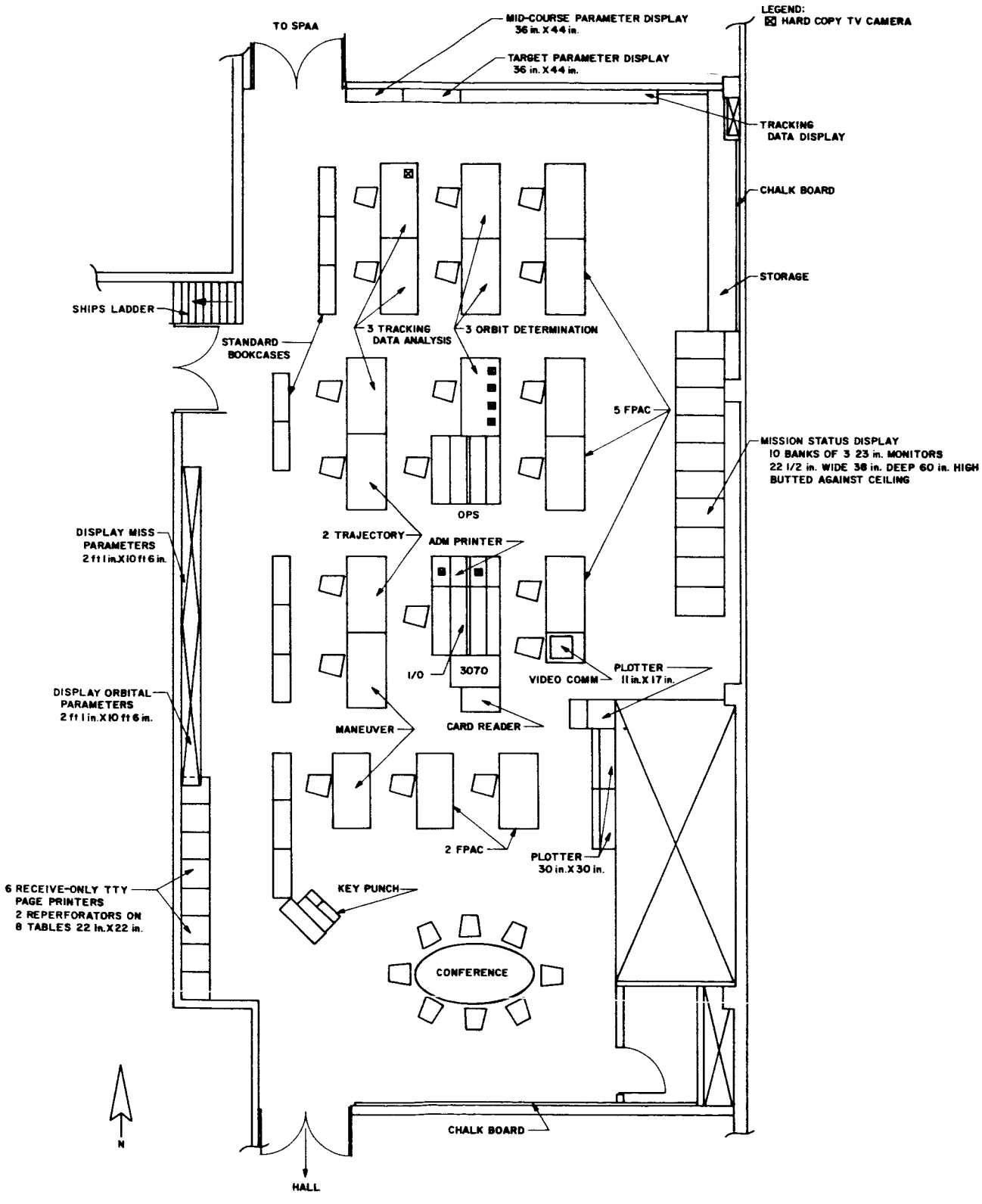



FIGURE II-9. FLIGHT PATH ANALYSIS AREA LAYOUT

The DSIF Net Control Room is located on the first floor of the SFOF, adjacent to the Operations Area (see Figure II-6). Operation of the DSIF is controlled and coordinated from this room. A remote inquiry station of the Data Processing System and a substation of the SFOF Communications System are located in the DSIF Net Control Room to permit monitoring of the tracking and telemetry data obtained by the Deep Space Network (DSN) for operational purposes. The FPAC provides additional support to the DSIF by monitoring the quality of the tracking data in the FPAA.

3. Mission-Independent Functions in the SFOF

The relatively mission-independent functions in the SFOF are located in the operational areas of the SFOF and are divided into four major systems: a) the Data Processing System, b) the Communications System, c) the Display System, and d) the Support System.

a. Data Processing System

The Data Processing System (DPS) is located in the Data Processing Area on the second floor of the SFOF (see Figure II-10). The major elements of the DPS are the Computer Subsystem, the Telemetry Processing Station Subsystem, the Data Processing Control and Display Subsystem, and the Programming Subsystem. Use of the DPS and of the remote inquiry stations in the SFOF is controlled from the Data Processing Control Console located in the Operations Area.

b. Communications System

All communications utilized during the Surveyor space flight operations terminate in the Communications Area in the SFOF. All incoming and outgoing voice, teletype, high-speed data, and spacecraft television communications are controlled from, and distributed in the Communications Control Room (see Figure II-11). All internal communications in the SFOF will also be provided by this system.

c. Display System

The Display System provides the capability of displaying summary, semidetailed, and detailed information about both mission-dependent and mission-independent operations associated with the space flight in the technical and operational areas of the SFOF. The overall status of the Surveyor mission will be maintained on a current basis on the Mission Status Board in the Operations Area.

d. Support System

The Support System provides the services required by the technical and operational personnel during the space flight operations. Maintenance laboratories are provided in the basement.

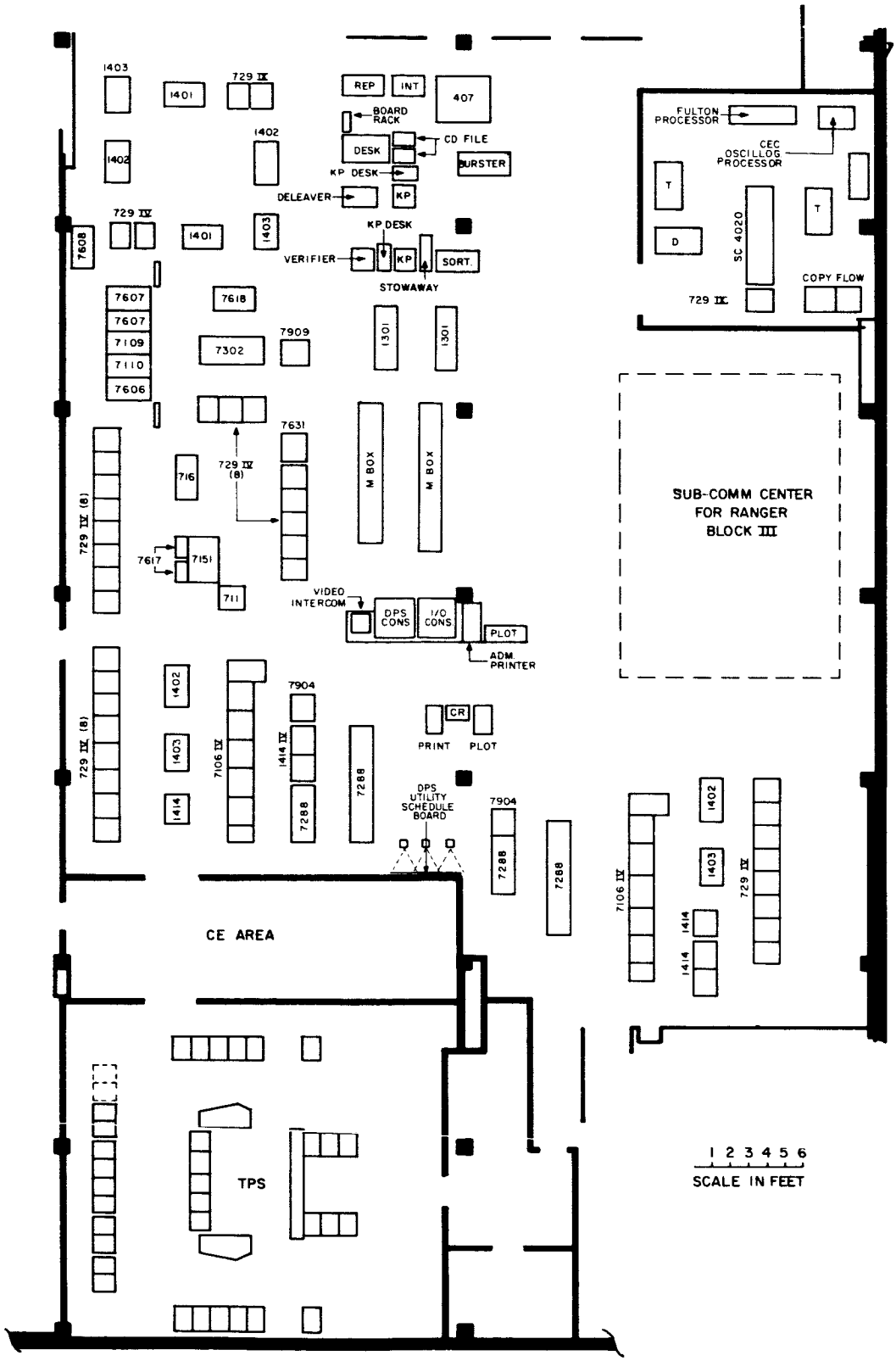



FIGURE II-10. DATA PROCESSING AREA FLOOR PLAN

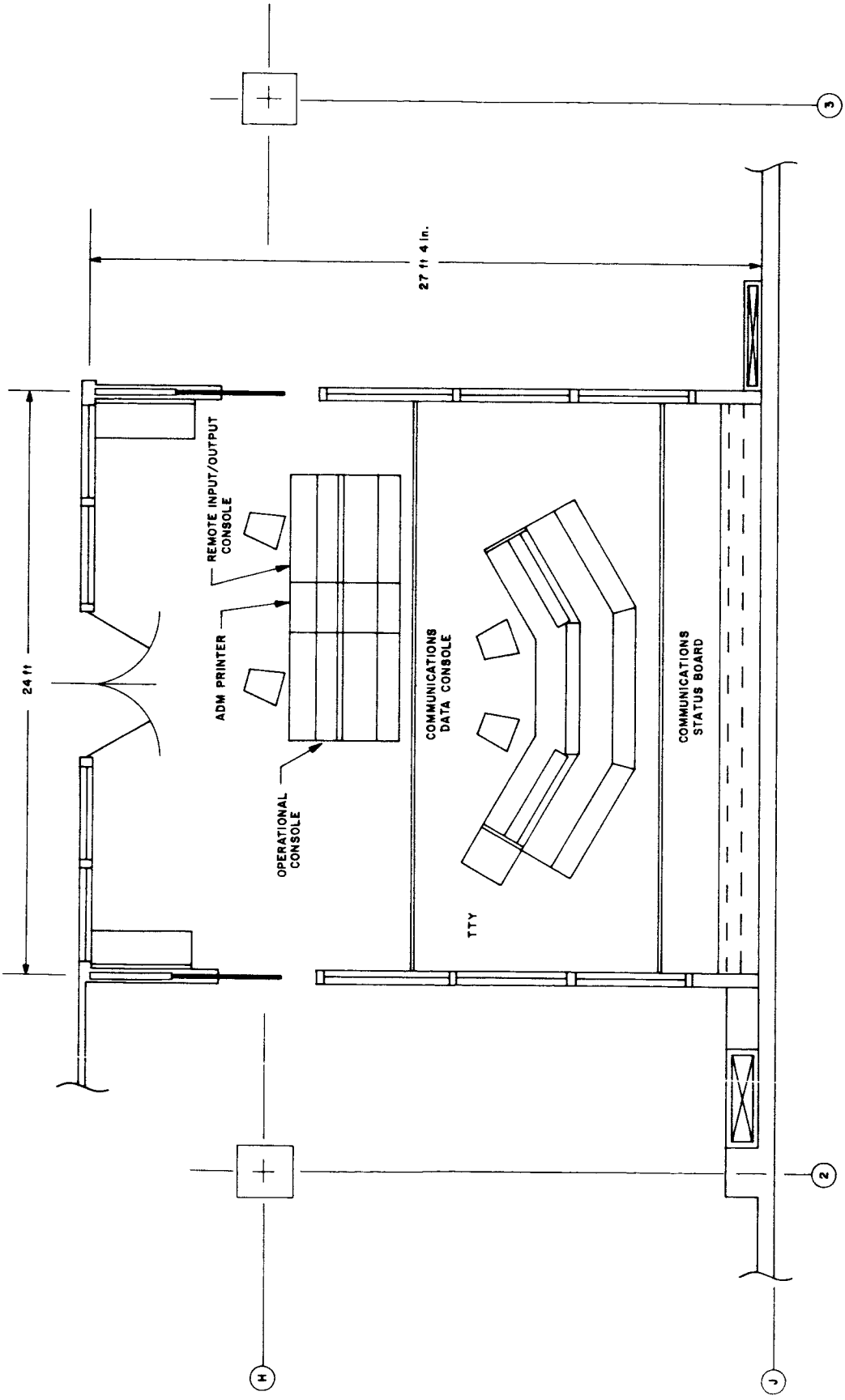



FIGURE II-11. COMMUNICATIONS CONTROL ROOM LAYOUT

A Standby Room and separate men's and women's dormitories are provided on the third floor. The SFOF Document Control Room, located on the third floor, is the central point for the receipt, indexing, and storage of all operational data obtained during the Surveyor mission.

4. Coverage

The SFOF will provide 24-hour-per-day coverage to the Surveyor P-42 Mission from launch to the end of the mission. Support, prior to launch, for the Surveyor space flight operations tests, will be provided as required in the Surveyor SFOS schedule.

5. DSN Ground Communications System

The DSN Ground Communications System for the Surveyor P-42 Mission is summarized in Table II-X.

TABLE II-X. TERRESTRIAL COMMUNICATIONS CAPABILITY AVAILABLE TO THE FIRST TWO SURVEYOR MISSIONS

| STATION | DIRECTION | FULL-PERIOD VOICE LINES | FULL-PERIOD TTY | HIGH-SPEED DATA | MICROWAVE |
|---|---|---|---|---|---|
| Goldstone | To SFOF | 4 | 6 | 2 | 60 cps to 6 mc<br>300 cps to 96 kc |
| | From SFOF | 4 | 6 | 0 | |
| Australia | To SFOF | 2 | 3 | 1* | |
| | From SFOF | 2 | 3 | 0 | |
| South Africa | To SFOF | 2 | 3 | 1** | |
| | From SFOF | 2 | 3 | 0 | |
| AFETR | To SFOF | 3 | 3 | 1* | |
| | From SFOF | 3 | 3 | 0 | |

* Assumes that all data is encoded to digital form for transmission, and capacity of each line is limited to 1200 bps.

** Assumes that all data is encoded to digital form for transmission, and capacity at the line is limited to 600 bps.

# SECTION III

# DATA FLOW

## A. GENERAL

It is the purpose of this section to describe the flow of data throughout the Space Flight Operations System (SFOS) for the Surveyor Project. This system includes the Air Force Eastern Test Range (AFETR), the Deep Space Instrumentation Facility (DSIF), and the Space Flight Operations Facility (SFOF), all of which are described in Section II.

## B. DATA FLOW

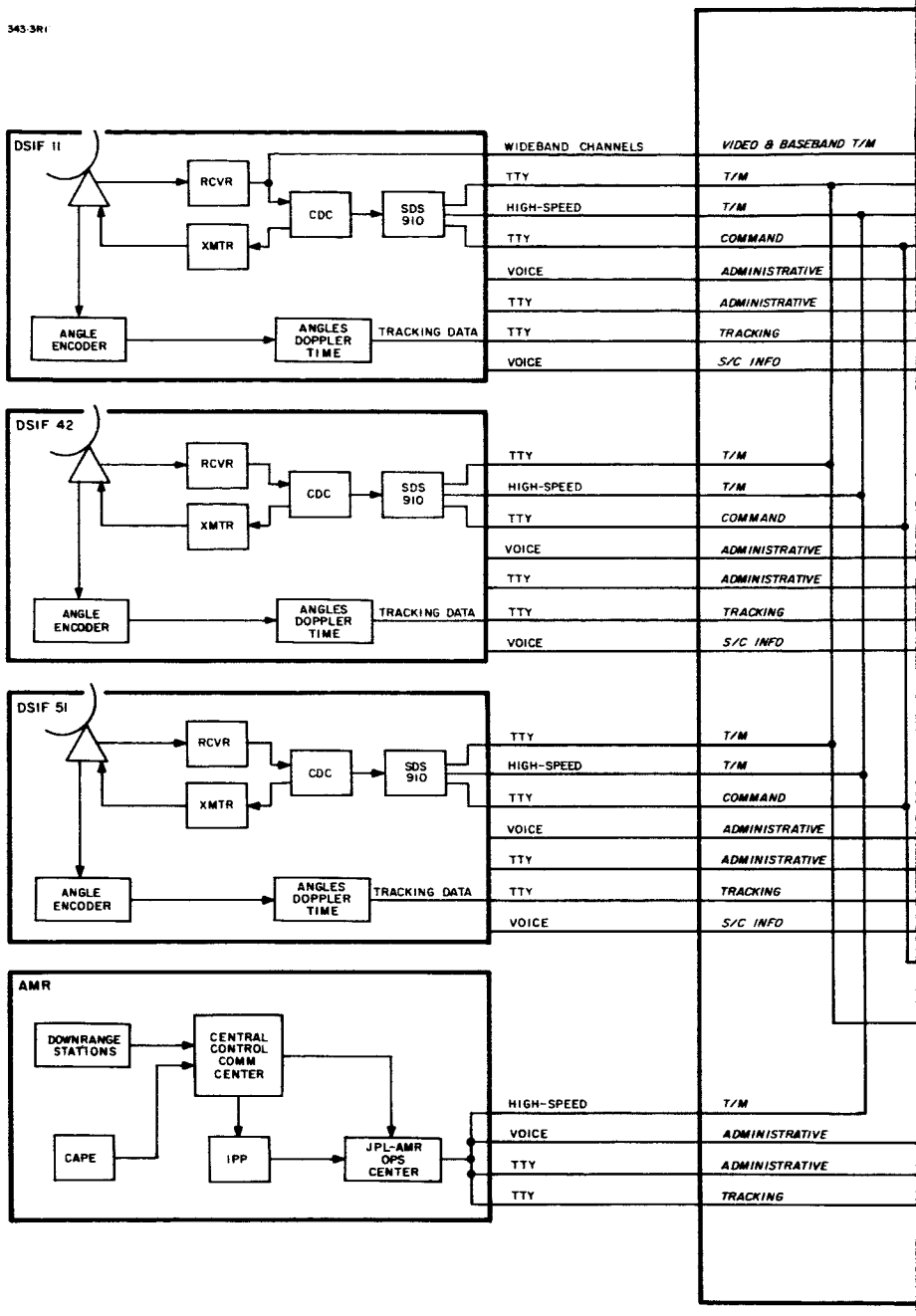
Data from AFETR will be obtained from before launch until after spacecraft/launch vehicle separation. This data will provide the information necessary for spacecraft acquisition by the DSIF stations, for computation of the preliminary spacecraft trajectory, and for preliminary evaluation of spacecraft performance. Data that is obtained from the DSIF will be used for real time monitoring of spacecraft performance and status, for near-real time spacecraft performance and flight path analysis, and for determining spacecraft and flight path commands. This data is transmitted from AFETR and the DSIF to the SFOF where computational processing comprises the major effort in data handling by the SFOF.

The nature of Surveyor space flight operations is such that the flow of data in real time is of prime concern. Figure III-1 indicates the types of data that will be obtained during the flights and the types of communications links over which this data may flow from AFETR and the DSIF to the SFOF. It may be seen in Figure III-1 that varied communications capabilities exist for transmitting data to the SFOF; however, this figure does not show specific line assignments or the number of lines available. Each type of data may be traced to its user in the SFOF. Figure III-2 details the flow of data from the SFOF to the DSIF. This data comprises spacecraft commands, antenna pointing angles, and administrative information. As in Figure III-1, this figure does not attempt to indicate information on-line assignments and priorities.

## C. DATA PROCESSING

Control of data flow and processing is necessary and will be exercised to ensure proper receipt and handling of data at the intervals specified in the Standard Sequence of Events. The principal users of spacecraft and spacecraft-related data, and the types of data primarily used are listed below.

| | Group | Type of Data |
|---|---|---|
| 1) | Spacecraft Performance Analysis and Command | Engineering Telemetry |
| 2) | Flight Path Analysis and Command | Tracking Data |




NOTE: This figure is not intended to show the number of circuits available of each type of communication link, nor to indicate assignments of data types to specific circuits.

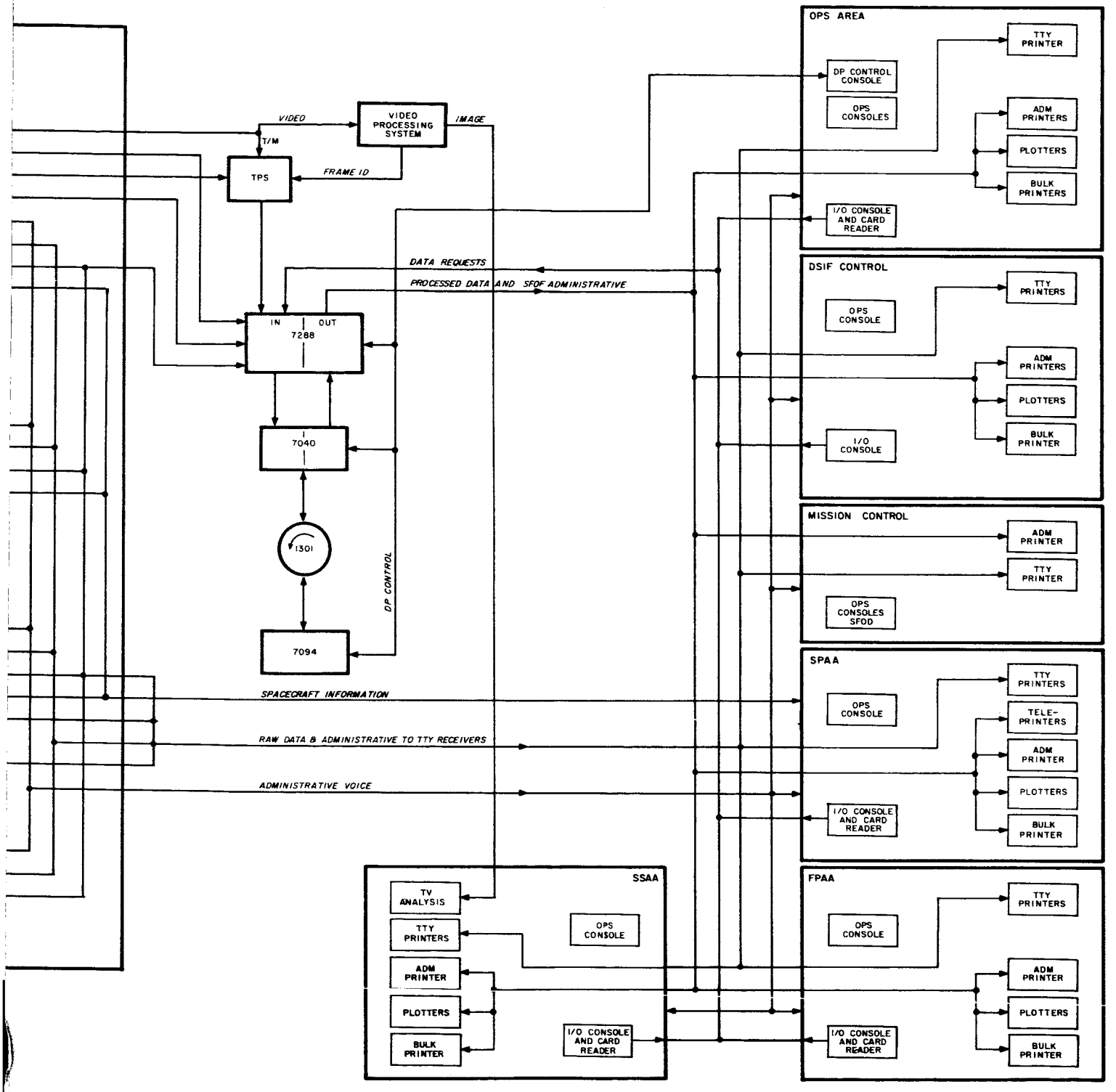
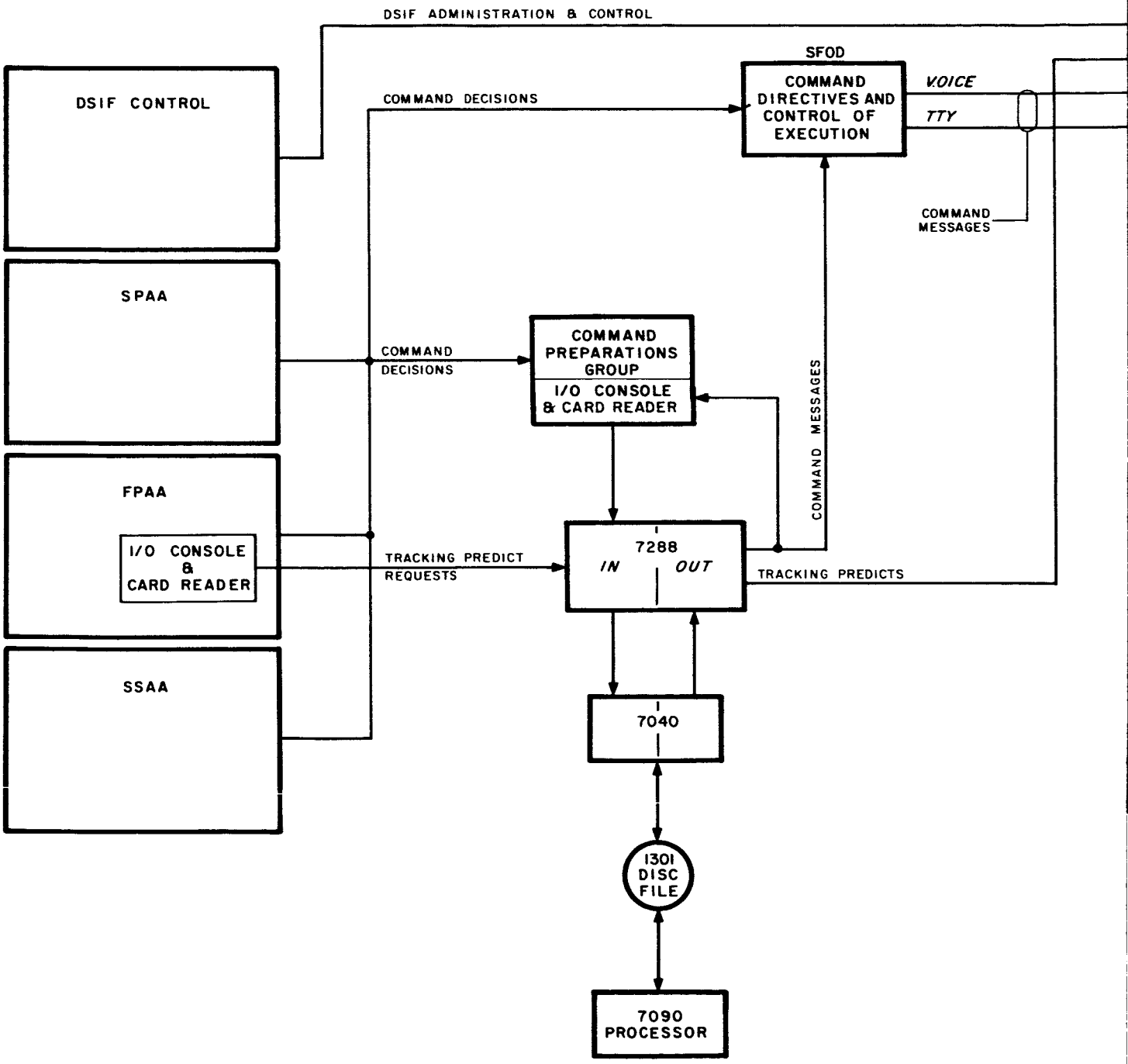



FIGURE III-1. SURVEYOR DATA FLOW TO CONTROL AND ANALYSIS AREAS IN SFOF

343-4RI


DSIF ADMINISTRATION & CONTROL
SFOD
DSIF CONTROL
COMMAND DECISIONS
COMMAND DIRECTIVES AND CONTROL OF EXECUTION
VOICE
TTY
COMMAND MESSAGES
SPAA
COMMAND DECISIONS
COMMAND PREPARATIONS GROUP
I/O CONSOLE & CARD READER
COMMAND MESSAGES
FPAA
I/O CONSOLE & CARD READER
TRACKING PREDICT REQUESTS
7288
IN
OUT
TRACKING PREDICTS
SSAA
7040
1301 DISC FILE
7090 PROCESSOR

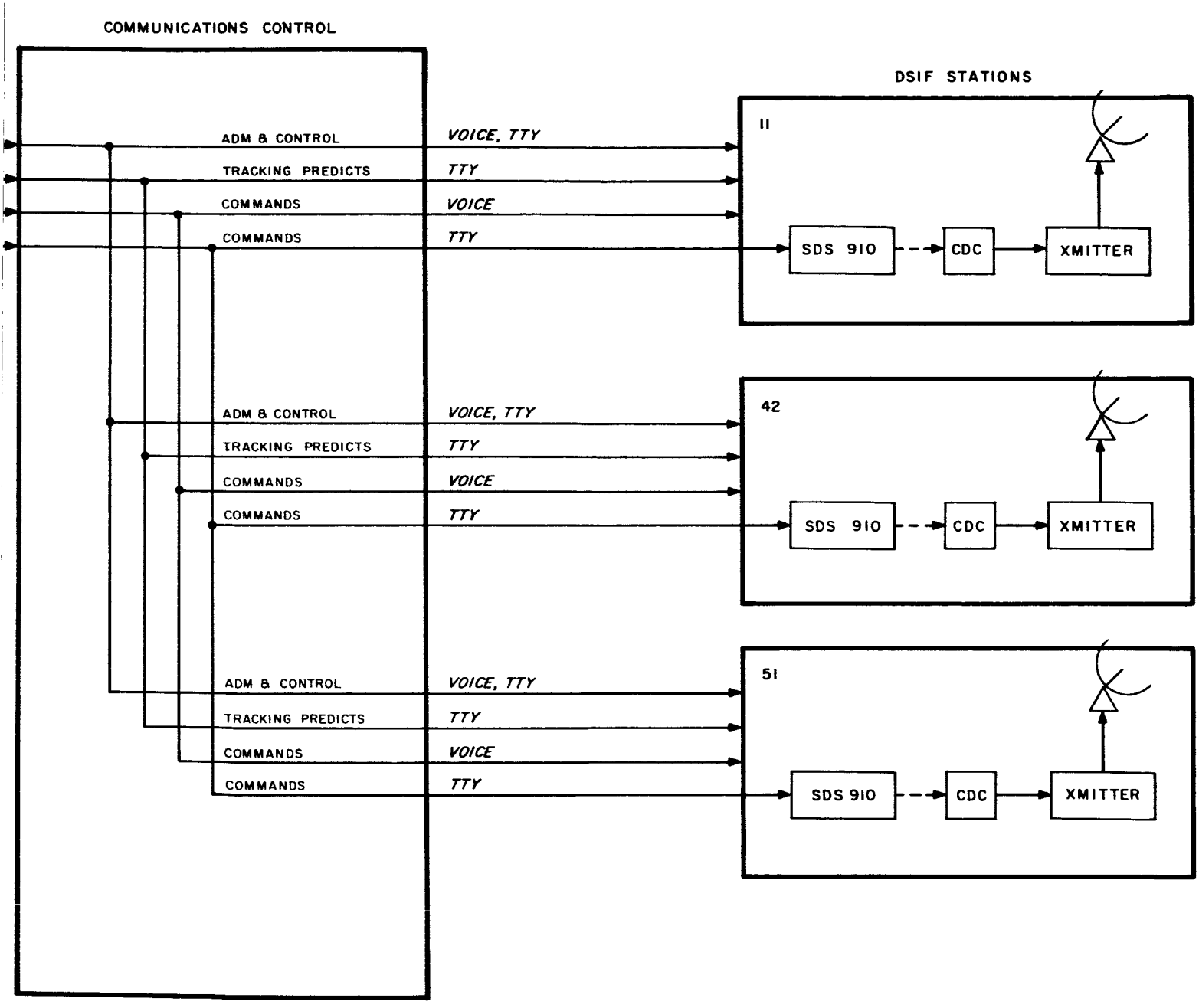



FIGURE III-2. SURVEYOR DATA FLOW FROM SFOF

| | | |
|---|---|---|
| 3) | Space Science Analysis and Command | Video and Touchdown Dynamics Data |
| 4) | Mission, Operations, and DSIF Net Control | Summary and Status Information |

It is the responsibility of these groups to interpret, analyze, and evaluate the type of data for which they are cognizant. The type of data and the requirements placed by the users determine the types of computation and processing that are performed. A detailed breakdown of data processing within the SFOF may be found in the Surveyor Standard Operating Procedures (SOP) document, EPD-____*. Similarly, additional details concerning internal data flow may be obtained from the Surveyor Tracking Instruction Manual (TIM), EPD-____* for the DSIF and in the Surveyor Program Support Plan (PSP)* for AFETR.

All records of data obtained by the AFETR will be forwarded to:

SFOF Document Control
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, California

All records of data acquired by the DSIF will be forwarded to the above address within 48 hours of the time of recording.

* Unpublished this date.

# SECTION IV

# SPACECRAFT COMMANDS

## A. INTRODUCTION

This section describes the operational aspects of the facilities available for the ground control of the Surveyor spacecraft and states the general procedures for their use in the Surveyor Command System.

Simplification of the spacecraft and increased flexibility of operation during a mission have been gained by holding to a minimum the flight sequences that are preprogrammed into the spacecraft control system. The spacecraft is controlled, to a large extent, by commands transmitted from the ground. Consequently, there is a requirement for highly developed organizational and operational procedures for the preparation and transmission of commands to the spacecraft.

## B. BASIC DEFINITIONS OF TERMS RELATING TO SURVEYOR SPACECRAFT COMMANDS

### 1. Command

One of the command words listed in Tables IV-I through IV-VIII (see page IV-13). A command, when received by the spacecraft, produces a particular spacecraft response. Two types of commands are defined:

a) Type 1. Direct Command

A Direct Command produces an immediate spacecraft response. Each such command is uniquely identified by a four-digit octal command number, the first and third digits of which cannot exceed three in value.

b) Type 2. Quantitative Command

A Quantitative Command determines the duration of a particular spacecraft response initiated by a subsequent associated Direct Command. A Quantitative Command is represented by a four-digit, octal number (the first and third digits of which cannot exceed three) having a value determined by the desired time duration of the spacecraft response.

### 2. Command Sequence

A command or series of commands which, when received by the spacecraft, produces a particular spacecraft response or series of responses. Each command sequence is uniquely identified by a four-digit, octal number.

3. Command Message

A statement originating in the SFOF containing commands and/or instructions and concerning the disposition of commands and/or command sequences by the DSIF. Two command message types, which are transmitted only by teletype, are:

a) Type 1. This results in the production of a CDC command tape at the DSIF.

b) Type 2. This includes all other teletype command messages.

4. Command/Command Sequence/Command Message Return Transmission

The process of transmitting a command/command sequence/command message from the DSIF to the SFOF.

5. Command/Command Sequence Execution

The transmission of a command/command sequence from the DSIF to the spacecraft.

6. Command Decision

The decision that a particular series of commands be executed at a particular time. (The implementation of this decision is distinct from the decision itself and from the process through which the decision is reached.)

7. Command Message Preparation

The process whereby a command message is obtained at the SFOF in the proper representation for transmission to the DSIF. (The process of command message preparation occurs subsequent to, and is distinct from the command decision. It is also distinct from the command message transmission to the DSIF, and the disposition of the command message after transmission.) To establish that the representation so obtained is correct is part of the command preparation.

8. Command Request

The request for permission to transmit a command message from the SFOF to the DSIF. This request is directed from a technical area to the SFOD. The command request will normally occur after command preparation is completed.

9. Command Directive

The instruction by the SFOD to the SFOF Operations Manager to transmit a command message from the SFOF to the DSIF.

10. Command Verification

A process whereby it is determined at the SFOF whether information at the DSIF pertaining to a command/command sequence/command message is correct. The following examples of command verification are of particular importance:

a) Verification prior to launch that preprepared command tapes at the DSIF are correct.

b) Verification that a teletype command message has been correctly received by the DSIF.

c) Verification that a CDC command tape is in position for execution of the proper command sequence.

d) Verification that a correct command has been entered on the CDC keyboard, prior to execution.

11. Command Confirmation

The process whereby it is determined at the SFOF whether a command or command sequence has been executed correctly by the DSIF and whether the spacecraft has responded correctly. The following are examples of command confirmation:

a) Confirmation of correct execution by the DSIF.

b) Confirmation of correct storage of a Quantitative Command in the spacecraft.

c) Confirmation of correct spacecraft response to commands or command sequences. This is an indirect process.

12. Command System

The total means, within the Surveyor Space Flight Operations System, available to implement command decisions.

13. Command System Alternative

A preselected subsystem of the command system specified for use in implementing command decisions.

## C. GENERAL POLICY GOVERNING OPERATIONAL PROCEDURES FOR CONTROL AND UTILIZATION OF THE SURVEYOR COMMAND SYSTEM

The general policy formulated for the Operational Procedures to be exercised for the control and utilization of the Surveyor Command System is defined in the following paragraphs.

1) All command decisions and command requests will be originated by, and only by one of the FPAC, SPAC, or SSAC Directors. This SFOP for Surveyor details specific responsibilities for these decisions and requests.

2) Transmission of command messages from the SFOF to the DSIF shall occur only by Command Directive that must be issued by, and only by the SFOD or his designated alternate.

3) No commands or command sequences will be executed by the DSIF without the approval of the SFOD except in such cases as are specifically noted in this document.

4) Command System Alternatives shall be selected only from among those listed in this document; such selection is to be in accordance with the specified requirement for the operational situation encountered.

5) Utilization of Command System Alternatives in standard space flight operations shall be based, in all cases, on appropriate detailed operating procedures that are prepared prior to, and verified during the SFO Test Phase.

6) The SFOD shall be responsible for interpretation of the details of the general policy stated herein and for the development of a Surveyor Command Procedure based on this policy.

## D. SPACECRAFT COMMAND SUBSYSTEM

The Surveyor spacecraft command subsystem consists of two identical receivers and two central command decoders (for reliability in the command link) and a set of subsystem decoders, located in the various spacecraft subsystems (e. g., flight control, electrical power). Command information is transmitted to the spacecraft as a binary wavetrain, frequency modulated on a subcarrier that, in turn, phase modulates the DSIF transmitter. The spacecraft receiver recovers the binary wavetrain and routes it to the central command decoder.

The basic command word is 24 bits in length. Two types of commands are transmitted to the spacecraft: direct and quantitative. (The command word formats are shown in Figure IV-1. Tables IV-I through IV-VIII list direct command words and the proper spacecraft responses.) Direct Commands, most of which initiate some action by the spacecraft, are identified by a four-digit octal number. The central decoder routes an ordinary command to the subsystem decoder signified by the first two digits of its octal identification. The subsystem decoder then initiates the spacecraft response called out by the last two digits of the octal command number. A Quantitative Command establishes the length of time over which a spacecraft action initiated by a subsequent Direct Command shall occur. Quantitative Commands are routed by the central command decoder to the flight control subsystem decoder for decoding and storage.

| Bit Numbers | 1 4 | 5 9 | 10 14 | 15 19 | 20 24 |
|---|---|---|---|---|---|
| Direct Command | Sync Signal | Complement of Subsystem Decoder Address | Subsystem Decoder Address (Binary equivalent of first two digits of octal command number) | Complement of Command Designation | Command Designation (Binary equivalent of last two digits of octal command number) |
| Quantitative Command | Sync Signal | Complement of Address | Address (octal 00) | Magnitude (10-digit binary number) | |

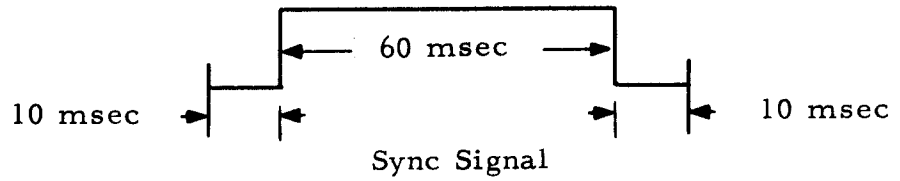



FIGURE IV-1. COMMAND WORD FORMATS

As protection against error, the central decoder performs a complement check on Direct Command words as a condition for entry into a subsystem decoder. Quantitative Commands, on the other hand, are immediately retransmitted by the spacecraft to the DSIF for confirmation that they have been correctly stored. So that the spacecraft can maintain bit and word synchronization, fill-in words are transmitted continuously between actual command words. These words have a format similar to that of Direct Commands; however, they violate the complement check and are not entered into subsystem decoders.

## E. GROUND COMMAND SYSTEM

Figure IV-2 shows, in functional form, the ground portion of the Surveyor Command System. This diagram shows the capabilities for:

1) Preparation of command messages

2) Transmission to the DSIF

3) Entry of commands into the CDC at the DSIF

4) Return transmission to the SFOF

5) Command verification

6) Command confirmation

### 1. Space Flight Operations Facility (SFOF)

Both the preparation and the verification of long or complex command messages will be implemented in the Computing Subsystem of the SFOF by means of the SCP/CVT Programs. These programs have the following capabilities:

a) To make up command messages for output on the communication link to the DSIF. (The Computing Subsystem has a direct electrical interface with the TTY link in the SFOF.)

b) To determine internally that the commands so prepared match the command dictionary stored in the Computing Subsystem disc file.

c) To display the command message in the user areas for visual examination.

d) To verify correct transmission of command messages to the DSIF through bit-by-bit comparison of the return-transmitted and original messages. (Command messages return-transmitted via TTY will also enter the Computing Subsystem through direct electrical interface with the TTY link.) Any error is indicated and specifically identified by English language output in the technical area displays.

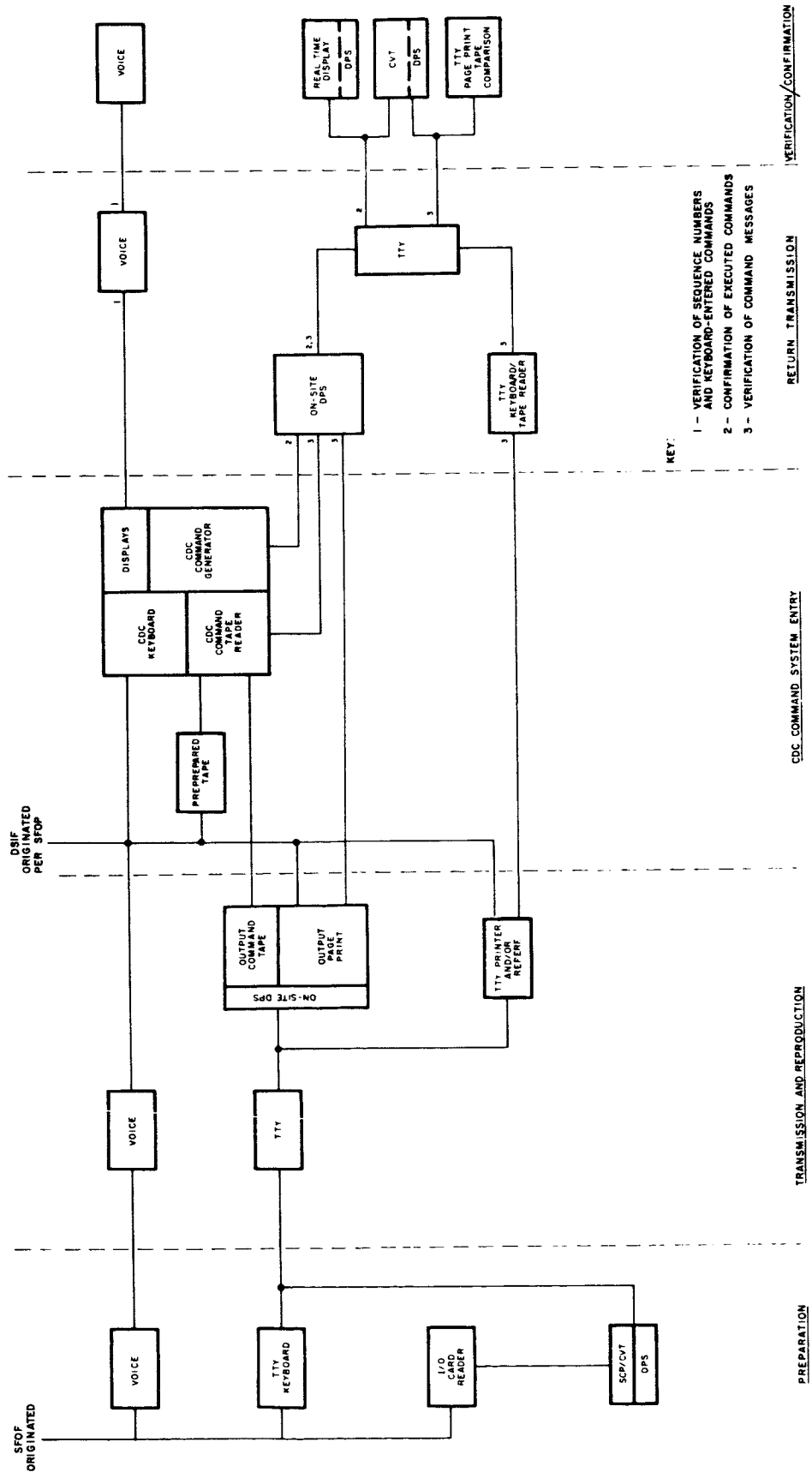



FIGURE IV-2. SURVEYOR COMMAND SYSTEM

e) To confirm commands transmitted to the spacecraft through bit-by-bit comparison of executed and original sequences. (This information will also enter the Computing Subsystem from the TTY link from DSIF through direct electrical interface.)

Additionally, command messages can be prepared for TTY transmission as manually punched TTY paper tape. Command messages can also be transmitted from the SFOF as verbal instruction over voice line. Verification can be implemented, if necessary, by the comparison of English language printouts of transmitted and return-transmitted TTY messages, or by machine comparison of transmitted and return-transmitted TTY tapes.

2. Deep Space Instrumentation Facility (DSIF) and Command and Data Handling Console (CDC)

Generation of the command signal that modulates the DSIF transmitter (the modulated subcarrier) is accomplished by the command subsystem of the CDC. Command words are entered in a ten-bit register in the CDC by sequentially depressing four of a set of octal keys, or through a punched mylar tape reader from tapes prepared before the mission or generated from TTY transmission during the mission. The octal command number (or magnitude) is, at this time, displayed on the console for operator examination. In the keyboard entry mode a "transmit" button initiates sequential readout of the register contents to modulate the SCO. The sync signal and the complement bits (in the case of Direct Command words) or address bits (in the case of Quantitative Commands) are generated automatically by the CDC logic. The CDC also generates the fill-in words from "canned" information. There are two modes of tape entry. In the "manual transmit" mode, the tape is advanced one step and a command is transmitted each time a "proceed" button is pressed. In the "automatic transmit" mode, the tape is advanced and commands are transmitted continuously from the time the "proceed" button is pressed until a "stop" button is pressed or a tape programmed stop is reached. The CDC will employ two command tape readers that can alternately be switched into the CDC command register or into the TTY link to the SFOF.

The command tapes contain, besides the command words, additional characters needed for tape control. In particular, command sequences are identified by their sequence numbers. The CDC incorporates an automatic search mode in which the tape reader locates the beginning of any specified command sequence on the tape.

Several features permit close control over any error in transmission to the spacecraft:

a) Information on the CDC tape can be entered from the CDC tape reader directly onto the TTY link to the SFOF without modulating the DSIF transmitter.

b) Whenever a command word is transmitted to the spacecraft, the command information is transmitted in real time via TTY to the SFOF.

c) The command subcarrier is also recorded on magnetic tape at the DSIF station to provide a record of all transmission to the spacecraft.

d) All commands executed are recorded, with the time of their execution, by the CDC Command Printer.

## F. COMMAND SYSTEM ALTERNATIVES

Command System Alternatives in space flight operations shall be selected from among Alternative Nos. 1, 2, and 3 defined below. The selection will be as specified for the operational situation encountered.

### 1. Alternative No. 1

Alternative No. 1 (Figure IV-3) will be used whenever the required command sequence(s) exist on a preprepared tape at the DSIF site.

### 2. Alternative No. 2

Alternative No. 2 (Figure IV-4) will be used in command situations for which there are no preprepared command tapes. In this mode, the command message will be return-transmitted in its entirety for verification before transmission to the spacecraft is begun.

### 3. Alternative No. 3

Alternative No. 3 (Figure IV-5) will be used in those situations for which there are no preprepared command tapes and time does not permit use of Alternative No. 2. In this mode, commands are entered in the CDC by Keyboard Entry Mode.

It may be desirable during the mission to use a combination of Alternative Nos. 1 and 3 when the desired command sequence is a minor variation of a sequence that exists on a preprepared tape. The preprepared tape will be entered in the CDC, and special or changed commands will be entered on the CDC keyboard as required.

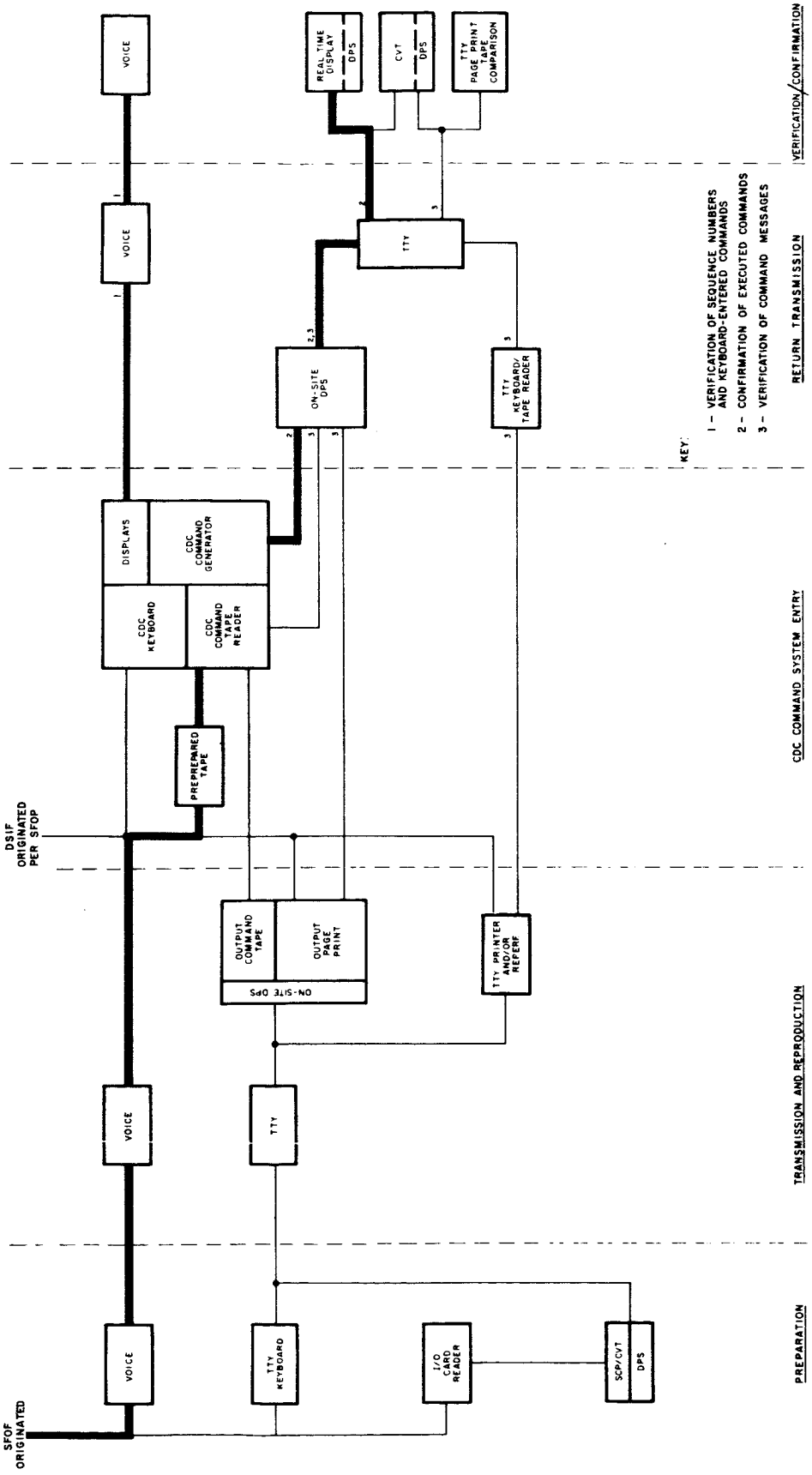



FIGURE IV-3. COMMAND SYSTEM ALTERNATIVE NO. 1

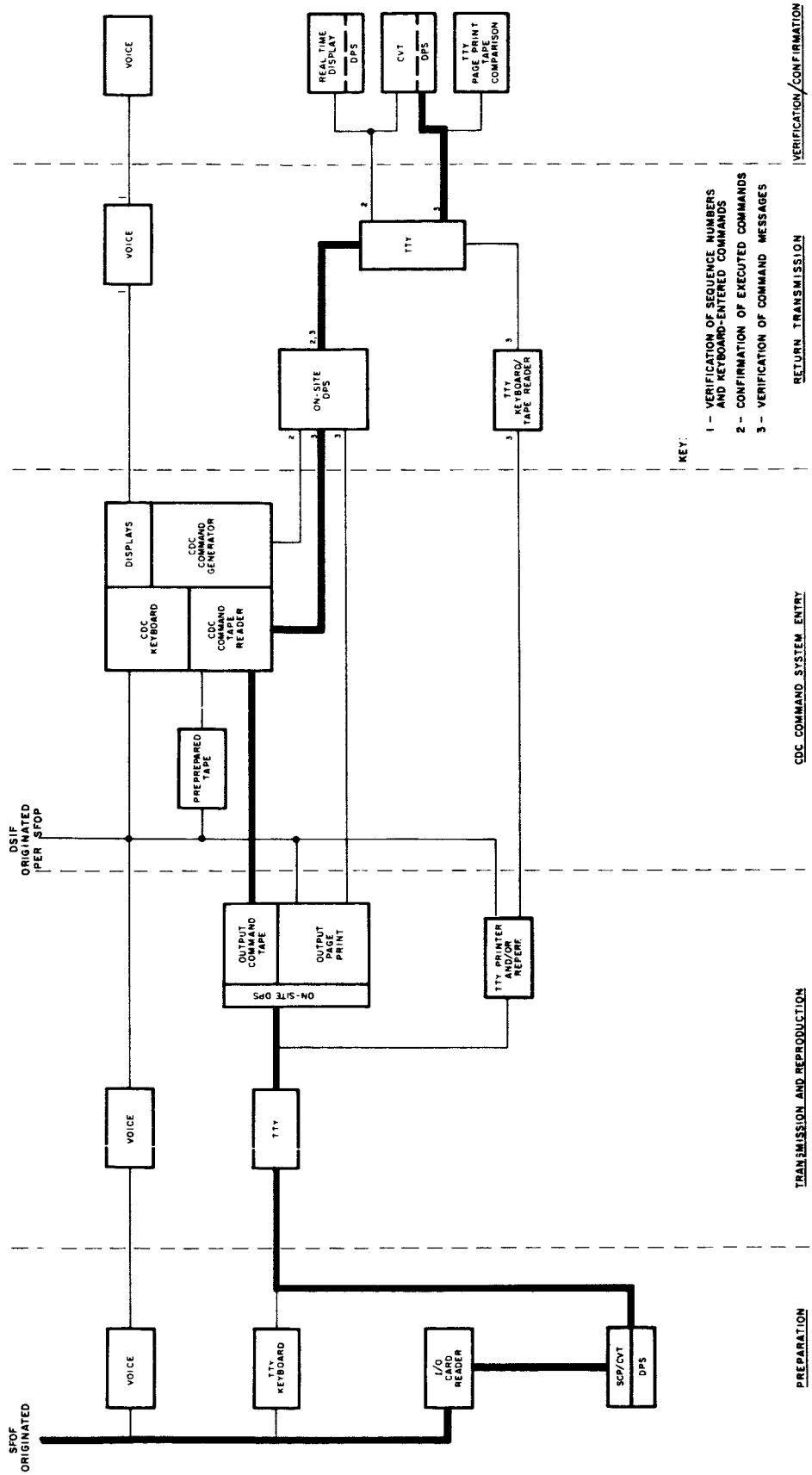



FIGURE IV-4. COMMAND SYSTEM ALTERNATIVE NO. 2

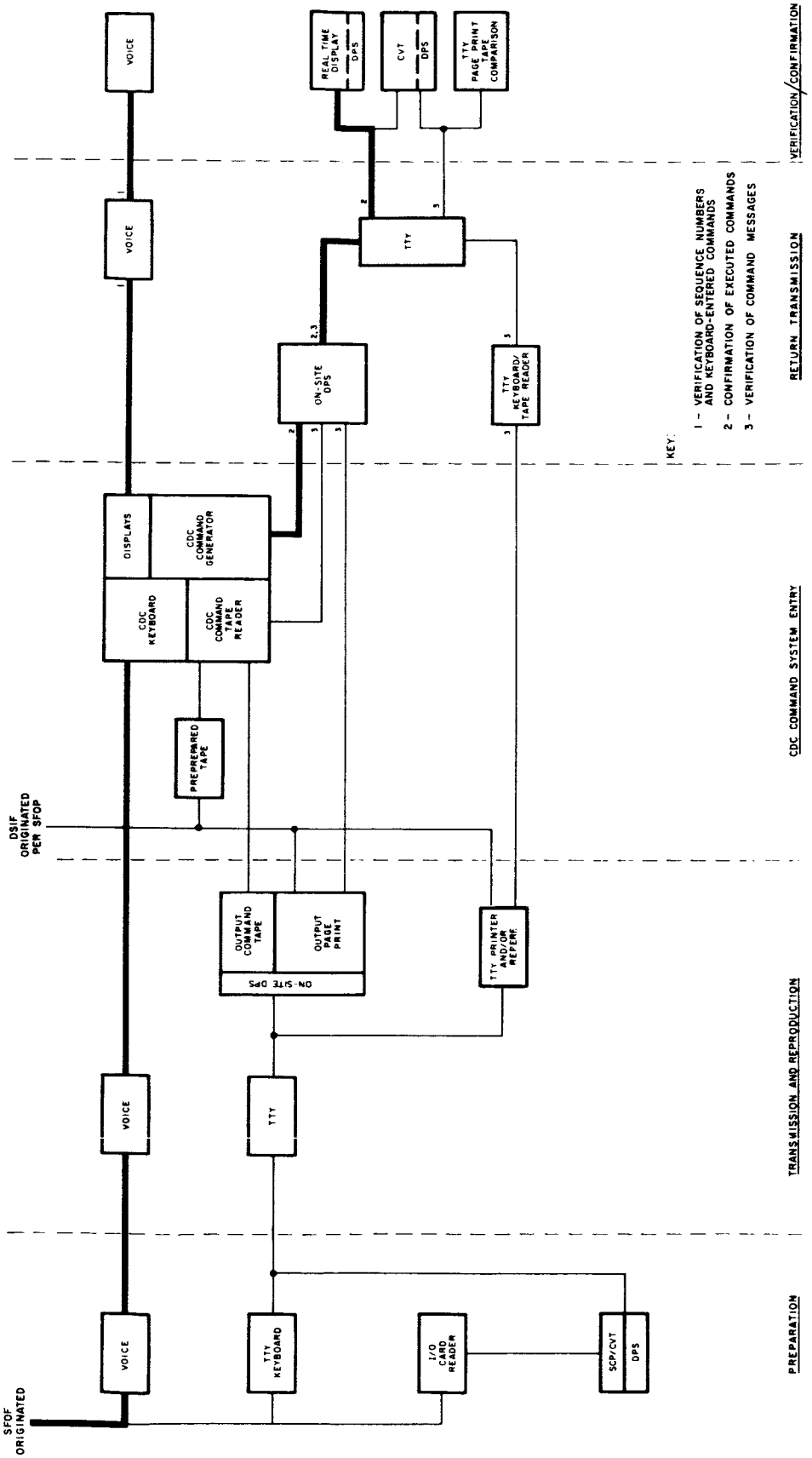



FIGURE IV-5. COMMAND SYSTEM ALTERNATIVE NO. 3

TABLE IV-I. LIST OF DIRECT COMMANDS

DECODER TITLE: DATA LINK AND TV APPROACH CAMERA (NO. 4)

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE (24 Characters) | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0100 | SPARE | |
| 0101 | XMTR-A-LOW-PWR-ON | Applies power to Transmitter A for low-power operation in the wide-band (WB) configuration. |
| 0102 | XMTR-A-FILA-PWR-ON | Applies filament power to Transmitter A in preparation for high-power operation. |
| 0103 | XMTR-A-HI-VOLTS-ON | Applies high voltage only if Commands 0102 and 0125 have been received. |
| 0104 | XMTR-B-LOW-PWR-ON | Applies power to Transmitter B for low-power operation in the wide-band configuration. |
| 0105 | XMTR-B-FILA-PWR-ON | Applies filament power to Transmitter B in preparation for high-power operation. |
| 0106 | XMTR-B-HI-VOLTS-ON | Applies high voltage only if Commands 0105 and 0127 have been received. |
| 0107 | XMTR-HI-VOLTS-OFF | Removes high voltage to operating transmitter(s). |
| 0110 | XMTR-FILA-PWR-OFF | Removes filament power and high voltage to operating transmitter(s). |
| 0111 | XMTR-LOW-PWR-OFF | Removes power to operating transmitter(s) and to VCXO(s). |
| 0112 | NARROW-BAND-VCXO-ON | Applies power to NB VCXO, NB phase modulator, and NB amplifier of operating transmitter. Also turns off WB VCXO. |

(This table continued on next page.)

TABLE IV-I. (CONT'D)

DECODER TITLE: DATA LINK AND TV APPROACH CAMERA (NO. 4)

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0113 | NARROW-BAND-VCXO-OFF | Removes power to operating NB VCXO and allows WB operation. |
| 0114 | HI-MOD-GAIN | Increases frequency deviation of main carrier. Used for emergency TV mode. |
| 0115 | NORM-MOD-GAIN | Restores normal frequency deviation of main carrier. |
| 0116 | XMTR-B-TO-PA | Switches Transmitter B to planar array and Transmitter A to omniantenna. |
| 0117 | XMTR-A-TO-PA | Switches Transmitter A to planar array and Transmitter B to omniantenna. |
| 0120 | SELECT-OMNI-A | Switches selected transmitter to Omniantenna A. |
| 0121 | SELECT-OMNI-B | Switches selected transmitter to Omniantenna B. |
| 0122 | XPONDER-A-PWR-ON | Applies power to Transponder A. |
| 0123 | XPONDER-B-PWR-ON | Applies power to Transponder B. |
| 0124 | XPONDER-PWR-OFF | Removes power to operating transponder(s). |
| 0125 | XFR-SW-A-HI-PWR | Switches antenna to output of Transmitter A final power amplifier. |
| 0126 | XFR-SW-A-LOW-PWR | Switches antenna to low-power output of Transmitter A. |

(This table continued on next page.)

TABLE IV-I. (CONT'D)

DECODER TITLE: DATA LINK AND TV APPROACH CAMERA (NO. 4)

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0127 | XFR-SW-B-HI-PWR | Switches antenna to output of Transmitter B final power amplifier. |
| 0130 | XFR-SW-B-LOW-PWR | Switches antenna to low-power output of Transmitter B. |
| 0131 | VDN-TEMP-CTRL-ON-APR-CAM | Applies power to temperature control system. |
| 0132 | PWR-ON-APRCH-CAMERA | Applies power to Camera No. 4 electronics. |
| 0133 | STR-FRM-APRCH-CAMERA | Initiates one frame which includes vertical sync and video. |
| 0134 | PWR-OFF-APRCH-CAMERA | Removes power to Camera No. 4 electronics. |
| 0135 | ALL-TEMP-CTRL-OFF-APR-CM | Removes power to electronics and vidicon temperature control. |
| 0136 | ELCT-TEMP-CTRL-ON-APR-CM | Turns on power to Camera No. 4 electronics heater. |
| 0137 | SPARE | |

TABLE IV-II. LIST OF DIRECT COMMANDS

DECODER TITLE: SIGNAL PROCESSING

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0200 | LOW-MOD-INDEX-SCO-ON | Applies power to SCO used for 550 bps transmission following separation and during lunar operation. |
| 0201 | A/D-CONV-1-PWR-ON | Applies power to clock and conversion circuitry. |
| 0202 | A/D-CONV-2-PWR-ON | Applies power to clock and conversion circuitry. |
| 0203 | A/D-CONV-PWR-OFF | Removes power to operating A/D converter. |
| 0204 | A/D-COAST-PH-CLK-RATES | Permits bit rate selection of 17.2 bps (OCT.0505), 137.5 bps (OCT.0504), or 550 bps (OCT.0503). |
| 0205 | A/D-CLK-RATE-11ϕϕ-BPS | Selects bit rate of 1100 bits per second (100 words per second, 11 bits per word). |
| 0206 | A/D-CLK-RATE-44ϕϕBPS | Selects bit rate of 4400 bits per second (400 words per second, 11 bits per word). |
| 0207 | PRE-SUM-AMP-ON | Applies power to PM presumming amplifier. |
| 0210 | PHSE-SUM-AMP-A-ON | Applies power to amplifier required to phase modulate Transmitter A. |
| 0211 | PHSE-SUM-AMP-B-ON | Applies power to amplifier required to phase modulate Transmitter B. |
| 0212 | FREQ-SUM-AMP-A-ON | Applies power to amplifier required to frequency modulate Transmitter A. |

(This table continued on next page.)

TABLE IV-II. (CONT'D)

DECODER TITLE: SIGNAL PROCESSING

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0213 | FREQ-SUM-AMP-B-ON | Applies power to amplifier required to frequency modulate Transmitter B. |
| 0214 | SUM-AMP-OFF | Removes power to presumming, phase and frequency summing amplifiers. |
| 0215 | 3.9 KC-A/D-SCO-ON | Applies power to SCO normally used for 550 bps transmission. |
| 0216 | 7.35 KC-A/D-SCO-ON | Applies power to SCO normally used for 1100 bps transmission. |
| 0217 | 33 KC-A/D-SCO-ON | Applies power to SCO normally used for 4400 bps transmission. |
| 0220 | 33, 7.35, 3.9 KC-SCOS-OFF | Removes power to SCO's and isolation amplifier used for transmission of A/D output. |
| 0221 | GYRO-SPEED-SIG-PROC-ON | Applies power to signal processor used for transmission of gyro speeds. |
| 0222 | SELECT-NEXT-GYRO-SPD-CNL | Selects roll, pitch, or yaw gyro speed. |
| 0223 | GYRO-SPD-SIG-PROC-OFF | Removes power to signal processor for gyro speed data. |
| 0224 | BASIC-BUS-ACCEL-CNLS-ON | Applies power to SCO's and presumming amplifier used to transmit accelerometer data. |
| 0225 | BASIC-BUS-ACCEL-CNLS-OFF | Removes power to SCO's and amplifier used to transmit accelerometer data. |

(This table continued on next page.)

TABLE IV-II. (CONT'D)

DECODER TITLE: SIGNAL PROCESSING

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0226 | ENGR-CMTR-1-ON | Applies power to commutator containing data required for midcourse correction. |
| 0227 | ENGR-CMTR-2-ON | Applies power to commutator required during terminal descent when transmitting on planar array. |
| 0230 | ENGR-CMTR-3-ON | Applies power to commutator required during terminal descent when transmitting on omniantenna. |
| 0231 | ENGR-CMTR-4-ON | Applies power to commutator containing data required during acquisition and lunar operation. |
| 0232 | ENGR-CMTRS-OFF | Removes power to all engineering commutators. |
| 0233 | CMD-REJ/ENBL-SCO-ON | Applies power to reject/enable SCO to allow real time monitoring via FM/FM channel. |
| 0234 | CMD-REJ/ENBL-SCO-OFF | Removes power from reject/enable SCO. |
| 0235 | A/D-ISOLTN-AMP-ON | Applies power to isolation amplifier to provide A/D output via Centaur telemetry. |
| 0236 | A/D-ISOLTN-AMP-OFF | Removes power from A/D isolation amplifier. |
| 0237 | LOW-MOD-INDEX-SCO-OFF | Removes power from SCO used for 550 bps transmission following separation and during lunar operation. |

TABLE IV-III. LIST OF DIRECT COMMANDS

DECODER TITLE: ELECTRICAL POWER

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0300 | FLT-CTRL-COAST-PZ-PWR-ON | Applies power to flight control circuits for Coast Phase attitude control. |
| 0301 | ENBLE-BATT-PRESS-LOGIC | Allows battery charging to be discontinued if battery manifold pressure exceeds 65 psi. |
| 0302 | DSBLE-BATT-PRESS-LOGIC | Disables battery pressure logic to permit battery charging. |
| 0303 | SPARE | |
| 0304 | BYPS-MN-OTC | Bypasses overcurrent sensing circuitry in nonessential regulated bus. |
| 0305 | ENBLE-MN-OTC | Applies power to nonessential regulated bus via overcurrent sensing circuitry. |
| 0306 | OCR-ON-&-BYPS-OFF | Applies power to OCR to maximize power transfer from solar panel to battery. |
| 0307 | OCR-BYPS-ON-&-OCR-OFF | Bypasses OCR to permit charging at reduced efficiency but at lower compartment dissipation. |
| 0310 | OCR-OFF | Turns off OCR and removes solar panel from power system. |
| 0311 | ALL-FLT-CTRL-PWR-OFF (I) | Removes power from flight control regulated and unregulated. |
| 0312 | SPARE | |
| 0313 | SPARE | |
| 0314 | NON-ESSEN-LOADS-OFF (I) | Removes power from nonessential regulated bus. |

(This table continued on next page.)

TABLE IV-III. (CONT'D)

DECODER TITLE: ELECTRICAL POWER

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0315 | SPARE | |
| 0316 | SPARE | |
| 0317 | AUX-BATT-MODE-ON | Connects main and auxiliary batteries to unregulated bus through isolation diodes. |
| 0320 | RESTORE-MAIN-BATT-MODE | Connects main battery directly to unregulated bus and removes auxiliary battery diode connection. |
| 0321 | DSBLE-BATT-XFR-LOGIC | Disables logic which switches system to auxiliary battery mode at low main battery voltage. |
| 0322 | HI-CUR-MODE-ON | Connects auxiliary battery directly to unregulated bus. |
| 0323 | HI-CUR-MODE-OFF | Removes direct connection between auxiliary battery and unregulated bus. |
| 0324 to 0337 | SPARE | |

TABLE IV-IV. LIST OF DIRECT COMMANDS

DECODER TITLE. MECHANISMS AND VEHICLE

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0400 | SPARE | |
| 0401 | STEP-SOLAR-PANEL-PLUS | Pulses stepping motor to move solar panel +0.125 degrees. |
| 0402 | STEP-SOLAR-PANEL-MINUS | Pulses stepping motor to move solar panel -0.125 degrees. |
| 0403 | STEP-POLAR-AXIS-PLUS | Pulses stepping motor to move polar axis +0.125 degrees. |
| 0404 | STEP-POLAR-AXIS-MINUS | Pulses stepping motor to move polar axis -0.125 degrees. |
| 0405 | STEP-ROLL-AXIS-PLUS | Pulses stepping motor to move roll axis +0.125 degrees. |
| 0406 | STEP-ROLL-AXIS-MINUS | Pulses stepping motor to move roll axis -0.125 degrees. |
| 0407 | STEP-ELEV-AXIS-PLUS | Pulses stepping motor to move elevation axis +0.125 degrees |
| 0410 | STEP-ELEV-AXIS-MINUS | Pulses stepping motor to move elevation axis -0.125 degrees. |
| 0411 | COMPT-A-HTR-PWR-ON | Supplies power directly to Compartment A heater. |
| 0412 | COMPT-A-THRM-CTRL-AUTO | Supplies power to Compartment A heater through a proportional control. |
| 0413 | COMPT-A-HTR-PWR-OFF | Removes heater power. |
| 0414 | COMPT-B-HTR-PWR-ON | Supplies power directly to Compartment B heater. |

(This table continued on next page.)

TABLE IV-IV. (CONT'D)

DECODER TITLE: MECHANISMS AND VEHICLE

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0415 | COMPT-B-THRM-CTRL-AUTO | Supplies power to Compartment B heater through a proportional control. |
| 0416 | COMPT-B-HTR-PWR-OFF | Removes heater power. |
| 0417 to 0437 | SPARE | |

TABLE IV-V. LIST OF DIRECT COMMANDS

DECODER TITLE: ENGINEERING PAYLOAD

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0500 | COAST-PH-I-A/D-SCO-ON | Applies power to SCO normally used for 137.5 bps transmission. |
| 0501 | COAST-PH-II-A/D-SCO-ON | Applies power to SCO normally used for 17.2 bps transmission. |
| 0502 | COAST-PH-A/D-SCO-OFF | Removes power from Coast Phase I and Coast Phase II A/D SCO's. |
| 0503 | A/D-CLOCK-RATE-55$\phi$-BPS | Selects bit rate of 550 bits per second (50 words per second, 11 bits per word). |
| 0504 | A/D-CLOCK-RATE-137.5-BPS | Selects bit rate of 137.5 bits per second (12.5 words per second, 11 bits per word). |
| 0505 | A/D-CLOCK-RATE-17.2-BPS | Selects bit rate of 17.2 bits per second (1.56 words per second, 11 bits per word). |
| 0506 | COAST-PH-CMTR-ON | Applies power to commutator required for Coast Phase. |
| 0507 | TRST-PH-BACK-UP-CMTR-ON | Applies power to backup commutator in case of failure of commutators 1, 2, 3 during mid-course correction or terminal descent. |
| 0510 | AUX-CMTR-OFF | Turns off power to Coast Phase commutator and Thrust Phase backup commutator. |
| 0511 | AUX-ACCEL-AMP-ON | Applies power to four accelerometer amplifiers: one near Compartment A, one near B and two on solar panel mast. |

(This table continued on next page.)

TABLE IV-V. (CONT'D)

DECODER TITLE: ENGINEERING PAYLOAD

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0512 | AUX-ACCEL-AMP-OFF | Removes power to four auxiliary accelerometer amplifiers turned on by Octal Command 0511. |
| 0513 | AUX-ACCEL-DATA-CHAN-ON | Applies power to presumming amplifier and two SCO's used to transmit auxiliary accelerometer data. |
| 0514 | AUX-ACCEL-DATA-CHAN-OFF | Removes power to amplifier and SCO's used to transmit auxiliary accelerometer data. |
| 0515 | TD-STRN-GA-PWR-ON | Applies power to three shock absorber strain gage amplifiers. |
| 0516 | TD-STRN-GA-PWR-OFF | Removes power from three shock absorber strain gage amplifiers. |
| 0517 | TD-STRN-GA-DATA-CHNL-ON | Applies power to presumming amplifier and three SCO's used to transmit shock absorber strain gage data. |
| 0520 | TD-STRN-GA-DATA-CHNL-OFF | Removes power from amplifier and SCO's used to transmit shock absorber strain gage data. |
| 0521 | PROPUL-STRN-GA-PWR-ON | Applies power to three thrust-level strain gage amplifiers, one for each vernier engine. |
| 0522 | PROPUL-STRN-GA-PWR-OFF | Removes power to three thrust-level strain gage amplifiers. |
| 0523 to 0537 | SPARE | |

TABLE IV-VI. LIST OF DIRECT COMMANDS

DECODER TITLE: ENGINEERING MECHANISMS AUXILIARY

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0600 | EXTEND-LANDING-GEAR | Energizes squib-actuated pin-pullers to extend landing gear (normally actuated from Centaur). |
| 0601 | EXTEND-OMNI-ANTENNAS | Energizes squib-actuated pin-pullers to release boom latches (normally actuated from Centaur). |
| 0602 | SPARE | |
| 0603 | DUMP-NITROGEN-(I) | Energizes squib-actuated nitrogen dump valve. |
| 0604 | AMR-HTR-OFF | Removes AMR heater power. |
| 0605 | SPARE | |
| 0606 | SPARE | |
| 0607 | PRESSURE-VERNIER-SYS-(I) | Energizes squib-actuated helium release valve. |
| 0610 | DUMP-HELIUM-(I) | Energizes squib-actuated helium dump valve. |
| 0611 | VER-LINES-2-TCP-ON | Applies heater power to maintain temperature of Vernier Lines No. 2. |
| 0612 | VER-FUEL-TANK-2-TCP-ON | Applies heater power to maintain temperature of Vernier Fuel Tank No. 2. |
| 0613 | VL-2-&-VFT-2-TCP-OFF | Removes heater power from Vernier Lines No. 2 and Vernier Fuel Tank No. 2. |

(This table continued on next page.)

TABLE IV-VI. (CONT'D)

DECODER TITLE: ENGINEERING MECHANISMS AUXILIARY

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0614 | VER-LINES-1-TCP-ON | Applies heater power to maintain temperature of Vernier Lines No. 1. |
| 0615 | VER-OXDZ-TANK-2-TCP-ON | Applies heater power to maintain temperature of Vernier Oxidizer Tank No. 2. |
| 0616 | VL-1-&-VOT-2-TCP-OFF | Removes heater power from Vernier Lines No. 1 and Vernier Oxidizer Tank No. 2. |
| 0617 | VER-LINES-3-TCP-ON | Applies heater power to maintain temperature of Vernier Lines No. 3. |
| 0620 | VER-OXDZ-TANK-3-TCP-ON | Applies heater power to maintain temperature of Vernier Oxidizer Tank No. 3. |
| 0621 | VL-3-&-VOT-3-TCP-OFF | Removes heater power from Vernier Lines No. 3 and Vernier Oxidizer Tank No. 3. |
| 0622 | BB-ACCEL-AMPS-ON | Applies power to four accelerometer amplifiers. |
| 0623 | BB-ACCEL-AMPS-OFF | Removes power to accelerometer amplifiers turned on by Octal Command 0622. |
| 0624 | AMR-HTR-ON | Applies power to preheat AMR package. |
| 0625 | AMR-PWR-ON | Applies "warm-up" power to AMR. |

(This table continued on next page.)

TABLE IV-VI. (CONT'D)

DECODER TITLE: ENGINEERING MECHANISMS AUXILIARY

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0626 | ENABLE-AMR | "Operate" command to altitude marking radar. |
| 0627 | AMR-PWR-OFF-(I) | Removes power from AMR. |
| 0630 | RADVS-PWR-OFF-(I) | Energizes pyrotechnic switches which remove power from RADVS. |
| 0631 | UNLOCK-SOLAR-PANEL-(T) | Energizes squib-actuated pin-pullers to permit positioning of solar panel. |
| 0632 | UNLK-MAST-ROLL-AX | Energizes squib-actuated pin-pullers to permit mast roll axis positioning. |
| 0633 | SPARE | |
| 0634 | UNLK-ELEV-AXIS | Energizes squib-actuated pin-pullers to permit positioning of elevation axis. |
| 0635 | UNLK-SP-(L) | Energizes squib-actuated pin-pullers to permit positioning of solar panels. |
| 0636 | LOCK-LANDING-GEAR | Energizes squib-actuated locking mechanism to hold landing gear rigid. |
| 0637 | RADVS-PWR-ON-(I) | Energizes pyrotechnic switches which apply power to RADVS. |

TABLE IV-VII. LIST OF DIRECT COMMANDS

DECODER TITLE: FLIGHT CONTROL

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0700 | INERTIAL-MODE-ON | Output Sets I, II, and III are reset to provide inertial reference. |
| 0701 | RATE-LOCK-MODE-ON | Stops motion in all three spacecraft axes (roll, pitch, and yaw). |
| 0702 | SUN-ACQ-MODE-ON | Initiates automatic search in pitch and yaw to align roll axis with Sun. |
| 0703 | SUN-&-STAR-ACQ-MODE-ON | Initiates automatic search in roll to acquire Canopus after 0702. |
| 0704 | CRUISE-MODE-ON | Provide Sun and star lock-on or inertial reference if lock-on signals are absent. |
| 0705 | EMER-P-PRECESS-ENABLE | Performs function of pitch precession enable in case of emergency. |
| 0706 | ENABLE-GAS-JET-AMPS | Enables gas jet amplifiers in case of emergency. |
| 0707 | INHIBIT-GAS-JET-AMPS | Inhibits gas jet amplifiers in case of an emergency. |
| 0710 | POS-ANGLE-MANEUVER | Establishes polarity of attitude commands. |
| 0711 | ROLL | Initiates roll attitude maneuver preset by Quantitative Command. |
| 0712 | PITCH | Initiates pitch attitude maneuver preset by Quantitative Command. |
| 0713 | YAW | Initiates yaw attitude maneuver preset by Quantitative Command. |
| 0714 | SUN-&-ROLL | Maintains Sun lock-on and initiates roll attitude maneuver. |

(This table continued on next page.)

TABLE IV-VII. (CONT'D)

DECODER TITLE: FLIGHT CONTROL

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0715 | MANUAL-DELAY-MODE-ON | Prepares programmer to accept ground-controlled time interval. |
| 0716 | SPARE | |
| 0717 | SPARE | |
| 0720 | RESET-SET-IV-OUTPUTS | Resets Set IV outputs. |
| 0721 | MVC-OR-EVI-(I) | Initiates velocity increment correction corresponding to the stored magnitude. |
| 0722 | SELECT-NOM-THRUST-BIAS | Reduces thrust of vernier engines from 200 lb. total to 150 lb. total. |
| 0723 | RESET-NOM-THRUST-BIAS | Increases the thrust of vernier engines to nominal 200 lb. total. |
| 0724 | RETRO-SEQ-MODE-ON-(I) | Enables Set IV outputs and AMR signal. |
| 0725 | SPARE | |
| 0726 | SPARE | |
| 0727 | FLT-CTRL-TRST-PHZ-PWR-ON | Applies power to flight control circuits required for control of verniers and retro. |
| 0730 | EMER-AMR-SIG | Performs function of AMR signal in case of emergency. |
| 0731 | EMER-RETRO-IGN | Commands Flight Control Programmer to deliver retro ignition signal. |
| 0732 | EMER-RETRO-EJECT | Commands Flight Control Programmer to deliver retro eject and sets burnout latch circuit. |

(This table continued on next page.)

TABLE IV-VII. (CONT'D)

DECODER TITLE: FLIGHT CONTROL

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 0733 | EMER-START-PGRMD-THRUST | Sets delayed--post-burnout latch circuit, enabling vernier programmed thrust. |
| 0734 | EMER-RADVS-ON-SIG | Performs function of RADVS "on" signal in case of emergency. |
| 0735 | EMER-VENT-VERN-ENG-SIG | Performs function of vernier engine purge signal in case of emergency. |
| 0736 | TERM-VERN-ENG-VENT | Resets vernier engine purge latch circuit to terminate 5-min. engine purge cycle. |
| 0737 | THRUST-PHZ-PWR-OFF | Removes power to flight control circuits required for control of verniers and retro. |

TABLE IV-VIII. LIST OF DIRECT COMMANDS

DECODER TITLE: TELEVISION SURVEY CAMERA (NO. 3)

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 1100 | START-FRAME | Gates logic to initiate video transmission. |
| 1101 | SPARE | |
| 1102 | SPARE | |
| 1103 | SURVEY-CAMERA-PWR-ON | Turns on power to Camera No. 3. |
| 1104 | SURVEY-CAMERA-PWR-OFF | Turns off power to TV system electronics for Survey Camera. |
| 1105 | SHUTTER-NORM | Returns shutter to normal mode. |
| 1106 | SHUTTER-OPEN | Opens shutter under minimal light conditions. |
| 1107 | EMER-MODE-ON | Selects emergency scan rates and amplitude. |
| 1110 | SET-25-MM-FOCAL-LGTH | Energizes motor to drive lens assembly to 25 mm focal length. |
| 1111 | SET-100-MM-FOCAL-LGTH | Energizes motor to drive lens assembly to 100 mm focal length. |
| 1112 | IRIS-SERVO-ON | Iris servo loop closed to control f-stop automatically, provided iris is not at extreme setting. |
| 1113 | STEP-IRIS-OPEN | Pulses stepper motor to open iris one f-stop if iris servo loop is open. |
| 1114 | STEP-IRIS-CLOSED | Pulses stepper motor to close iris one f-stop if iris servo loop is open. |

(This table continued on next page.)

TABLE IV-VIII. (CONT'D)

DECODER TITLE: TELEVISION SURVEY CAMERA (NO. 3)

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 1115 | STEP-MIRROR-RIGHT | Pulses stepper motor to move mirror 3 degrees in azimuth to right. |
| 1116 | STEP-MIRROR-LEFT | Pulses stepper motor to move mirror 3 degrees in azimuth to left. |
| 1117 | 2-STEPS-MIRROR-RIGHT | Pulses stepper motor to move mirror 6 degrees to right. |
| 1120 | 2-STEPS-MIRROR-LEFT | Pulses stepper motor to move mirror 6 degrees to left. |
| 1121 | STEP-MIRROR-DOWN | Pulses stepper motor to move mirror 2.5 degrees down in elevation. |
| 1122 | STEP-MIRROR-UP | Pulses stepper motor to move mirror 2.5 degrees up in elevation. |
| 1123 | STEP-FOCUS-IN | Pulses stepper motor one step in (focus range: ∞ to 6 ft. in 50 steps). |
| 1124 | STEP-FOCUS-OUT | Pulses stepper motor one step out (focus range: 6 ft. to ∞ in 50 steps). |
| 1125 | MULT-STEP-FOCUS-IN | Starts stepper motor to run focus in until command is repeated. |
| 1126 | MULT-STEP-FOCUS-OUT | Starts stepper motor to run focus out until command is repeated. |
| 1127 | STEP-FLTR-POSITION-RIGHT | Pulses stepper motor to rotate filter wheel 90 degrees to right (360° maximum rotation). |

(This table continued on next page.)

TABLE IV-VIII. (CONT'D)

DECODER TITLE: TELEVISION SURVEY CAMERA (NO. 3)

| OCTAL COMMAND NUMBER | SHORT COMMAND TITLE | SPACECRAFT RESPONSE INITIATED |
|---|---|---|
| 1130 | STEP-FLTR-POSITION-LEFT | Pulses stepper motor to rotate filter wheel 90 degrees to left (360° maximum rotation). |
| 1131 | SPARE | |
| 1132 | SPARE | |
| 1133 | SURVEY-CAMERA-VTC-ON | Turns on power to Survey Camera vidicon heater. |
| 1134 | SURVEY-CAMERA-VTC-OFF | Turns off power to vidicon heater in Survey Camera. |
| 1135 | SPARE | |
| 1136 | SURVEY-CAMERA-ETC-ON | Turns on power to Camera No. 3 electronics heater. |
| 1137 | SURVEY-CAMERA-ETC-OFF | Turns off power to Survey Camera No. 3 electronics heater. |

# SECTION V

# STANDARD SEQUENCE OF EVENTS

## A. GENERAL

Table V-I, the Standard Sequence of Events, specifies an expected sequence of events during normal operation of the Atlas/Centaur vehicle, the Surveyor spacecraft, and the Space Flight Operations System.

This table will be changed as necessary. In particular, it is expected that the lunar approach and descent portion of the sequence may require considerable change. Subsequent revisions of this document will reflect these changes.

## B. LEGEND FOR TABLE V-I, STANDARD SEQUENCE OF EVENTS

### Time of Event Column

T - Countdown Time Before Liftoff

L - Time of Liftoff

I - Time of Injection

TD - Time of Touchdown

### Station Column

| | |
|---|---|
| A | - Mission Control, SFOF |
| Comm | - Communications Center, SFOF |
| Data | - Data Processing System, SFOF |
| Net | - DSIF Net Control, SFOF |
| E | - JPL/HAC Control, AFETR |
| FP | - Flight Path Analysis and Command (FPAC) |
| S/C | - Spacecraft |
| SF | - Space Flight Operations Facility (SFOF) |
| SP | - Spacecraft Performance Analysis and Command (SPAC) |
| SS | - Space Science Analysis and Command (SSAC) |
| TM | - Telemetry |

### AFETR and DSIF Stations

| | |
|---|---|
| AFETR 1.16, Tel II | - Cape Kennedy |
| AFETR 12 | - Ascension Island |
| AFETR 9.1 | - Antigua |
| DSIF 11 | - Goldstone Pioneer Station, California |
| DSIF 42 | - Canberra, Australia |
| DSIF 51 | - Johannesburg, South Africa |

TABLE V-I STANDARD SEQUENCE OF EVENTS

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| SS | T-10H | E | 1. SPACECRAFT READINESS TESTS BEGIN. |
| RR | T-6H | DATA | 1. START FINAL CHECKOUT OF DATA PROCESSING SYSTEM. |
| QQ | T-5H20M | COMM | 1. ESTABLISH COMMUNICATIONS BETWEEN SF, DSIF, AND AFETR. |
| PP | T-5H15M | 51 | 1. START PLAYBACK TO SF OF PREPARED COMMAND TAPES. |
| OO | T-5H10M | E | 1. REPORT TO A PLANNED GMT LAUNCH TIME AND START AND END OF LAUNCH WINDOW. |
| | | | 2. REPORT TO A STEA-S/C STATUS. |
| NN | T-5H6M | A | 1. ANNOUNCE PLANNED GMT LAUNCH TIME AND WINDOW TO SF, AND DSIF 11, 42, 51. |
| MM | T-5H | 11 | 1. START PLAYBACK OF PREPREPARED COMMAND TAPES TO SF. |
| LL | T-4H45M | 42 | 1. START PLAYBACK OF PREPREPARED COMMAND TAPES TO SF. |
| KK | T-4H40M | E | 1. REPORT TO A START OF ATLAS/CENTAUR COUNTDOWN. |
| JJ | T-4H30M | E | 1. REPORT TO A STATUS OF S/C COUNTDOWN. |
| II | T-4H20M | E | 1. REPORT TO A START OF RF SILENCE. |
| HH | T-4H | E | 1. REPORT TO A START OF ATLAS PROPULSION IGNITER INSTALLATION AND CONNECTION. |
| | | | 2. REPORT TO A START OF NOSE FAIRING EXPLOSIVE BOLT INSTALLATION AND CONNECTION. |
| GG | T-3H40M | A | 1. REPORT VERIFICATION OF PREPARED COMMAND TAPES TO DSIF 51, 11, 42. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| FF | T-3H40M | E | 1. REPORT TO A STATUS OF S/C COUNTDOWN. |
| EE | T-3H30M | E | 1. REPORT TO A START OF ATLAS AUTOPILOT TESTS. |
| DD | T-3H10M | E | 1. REPORT TO A COMPLETION OF ATLAS PROPULSION IGNITER INSTALLATION AND CONNECTION. |
| | | | 2. REPORT TO A COMPLETION OF NOSE FAIRING EXPLOSIVE BOLT INSTALLATION AND CONNECTION. |
| CC | T-2H40M | E | 1. REPORT TO A START OF CENTAUR AUTOPILOT TESTS. |
| | | | 2. REPORT TO A ACTIVATION OF ATLAS AND CENTAUR BATTERIES. |
| | | | 3. REPORT TO A STATUS OF S/C COUNTDOWN. |
| BB | T-2H | E | 1. REPORT TO A PREPARATION FOR TOWER REMOVAL. |
| AA | T-1H20M | E | 1. REPORT TO A END OF RF SILENCE. |
| | | | 2. REPORT TO A START OF ESTABLISHMENT OF RF LINK WITH S/C. |
| | | | 3. REPORT TO A STATUS OF S/C COUNTDOWN. |
| | | | 4. REPORT TO A REMOVAL OF TOWER. |
| Z | T-1H13M | E | 1. REPORT TO A COMPLETION OF ESTABLISHMENT OF RF LINK WITH S/C. |
| Y | T-1H12M | E | 1. START TRANSMISSION OF S/C TELEMETRY TO SF. |
| X | T-1H12M | DATA | 1. START PROCESSING S/C DATA AND PROVIDE PROCESSED DATA TO SF. |
| W | T-1H | E | 1. REPORT TO A START OF CENTAUR LOX |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| W | (CONTINUED) | | TANKING. |
| | | | 2. REPORT TO A REQUIRED S/C ELECTRONICS CONDITIONS FOR LAUNCH ESTABLISHED. |
| V | T-40M | E | 1. REPORT TO A COMPLETION OF CENTAUR LOX TANKING. |
| | | | 2. REPORT TO A START OF ATLAS LOX TANKING. |
| | | | 3. REPORT TO A STATUS OF S/C COUNTDOWN. |
| | | | 4. SEND S/C TRANSMITTER POWER, FREQUENCY, AND TEMPERATURE - ALSO RECEIVER FREQUENCY AND THRESHOLD MEASUREMENTS TO SP AND FP. |
| U | T-40M | SP | 1. REPORT TO A GENERAL VERIFICATION OF S/C STATUS. |
| T | T-35M | E | 1. REPORT TO A ATLAS/CENTAUR BATTERIES CHECKED. |
| S | T-35M | SP | 1. REPORT FREQUENCIES, FREQUENCY CORRECTIONS, AND DRIFT RATES TO FP. |
| R | T-25M | E | 1. REPORT TO A COMPLETION OF S/C SIGNAL PROCESSING CHECKOUT. |
| | | | 2. SEND S/C THERMAL AND POWER PROGRAM INPUT PARAMETERS TO SP. |
| | | | 3. REPORT TO A START OF CENTAUR LIQUID HELIUM TANKING. |
| | | | 4. REPORT TO A START OF FINAL RANGE SAFETY CHECK. |
| Q | T-20M | E | 1. SEND VALUES OF S/C TRANSMITTER POWER AND FREQUENCY - ALSO RECEIVER FREQUENCY TO SP AND FP. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| P | T-17M | E | 1. REPORT TO A COMPLETION OF FINAL RANGE SAFETY CHECK. |
| O | T-15M | E | 1. REPORT TO A TURN-OFF OF S/C EXTERNAL POWER AND TURN-ON OF S/C INTERNAL POWER. |
| | | | 2. REPORT TO A START OF S/C POWER PARAMETERS MONITORING. |
| N | T-15M | SP | 1. REPORT FREQUENCIES, FREQUENCY CORRECTIONS, AND DRIFT RATES TO FP. |
| M | T-15M | FP | 1. REPORT TO A TRANSMISSION OF FREQUENCY INFORMATION TO IPP. |
| L | T-12M | E | 1. REPORT TO A COMPLETION OF S/C POWER PARAMETERS MONITORING. |
| | | | 2. REPORT TO A TURN-OFF OF S/C INTERNAL POWER AND TURN-ON OF S/C EXTERNAL POWER. |
| K | T-12M | SP | 1. REPORT TO A S/C POWER SYSTEM STATUS. |
| J | T-10M | E | 1. REPORT TO A START OF CENTAUR LOX TOPPING. |
| | | | 2. REPORT TO A COMPLETION OF ATLAS/CENTAUR AUTOPILOT TESTS. |
| | | | 3. REPORT TO A COMPLETION OF S/C FLIGHT CONTROL CHECKS. |
| I | T-5M | E | 1. REPORT TO A COMPLETION OF ATLAS LOX TANKING. |
| | | | 2. REPORT TO A START OF ATLAS LOX TOPPING. |
| | | | 3. REPORT TO A LAUNCH PLAN. |
| H | T-5M | FP | 1. REPORT TO A START OF COMPUTATION OF INJECTION CONDITIONS WITH DIRECT ASCENT POWERED FLIGHT SIMULATION |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| H | (CONTINUED) | | PROGRAM BASED ON ESTIMATED LAUNCH TIME (IF REQUIRED) (94 X, Y). |
| G | T-4M | FP | 1. COMPLETE CALCULATION OF INJECTION CONDITIONS (IF REQUIRED). |
| | | | 2. BEGIN COMPUTATION OF PREDICTIONS (IF REQUIRED) (94X,Y). |
| F | T-3M | E | 1. REPORT TO A TURN-OFF OF CENTAUR EXTERNAL POWER AND TURN-ON OF CENTAUR INTERNAL POWER. |
| E | T-2M | E | 1. REPORT TO A TURN-OFF OF ATLAS EXTERNAL POWER AND TURN-ON OF ATLAS INTERNAL POWER. |
| | | | 2. REPORT TO A TURN-OFF OF S/C EXTERNAL POWER. |
| | | | 3. REPORT TO A COMPLETION OF ATLAS LOX TOPPING. |
| | | | 4. REPORT TO A COMPLETION OF CENTAUR LIQUID HELIUM TANKING. |
| | | | 5. SEND CRITICAL S/C TEMPERATURE AND POWER PARAMETER DATA TO SP. |
| D | T-2M | SP | 1. REPORT TO A S/C TEMPERATURE AND POWER DATA. |
| C | T-1M | E | 1. REPORT TO A ATLAS AND CENTAUR ARMED. |
| B | T-18S | E | 1. REPORT TO A START OF ATLAS ENGINE. |
| A | T-17S | E | 1. REPORT TO A CENTAUR UPPER UMBILICAL REMOVED. |
| 1 | L=T-0 | E | 1. LIFTOFF. REPORT TO A LIFTOFF TIME. |
| 2 | T=0 | IPP | 1. START REAL TIME RANGE SAFETY IMPACT PREDICTION. |
| 3 | T=0 | A | 1. ANNOUNCE LIFTOFF TIME TO SF AND DSIF |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 3 | (CONTINUED) | | NET. |
| 4 | L+30S | E | 1. REPORT TO A ACQUISITION BY AFETR TEL II.<br>2. REPORT TO A RECEPTION OF S/C T/M (VHF) FROM AFETR TEL II.<br>3. BEGIN TRANSMISSION OF S/C T/M FROM AFETR TEL II TO SF. |
| 5 | L+2M | FP | 1. COMPLETE COMPUTATION OF PREDICTIONS BASED ON ESTIMATED LAUNCH TIME (IF REQUIRED) (94 X, Y).<br>2. REPORT TO A START OF COMPUTATION OF INJECTION CONDITIONS WITH DIRECT ASCENT POWERED FLIGHT SIMULATION PROGRAM BASED ON ANNOUNCED LAUNCH TIME (94 X, Y). |
| 6 | L+ | E | 1. REPORT TO A ATLAS BOOSTER ENGINE CUTOFF (BECO). MARK 1. |
| 7 | L+ | E | 1. REPORT TO A ATLAS BOOSTER ENGINE JETTISON. MARK 2. |
| 8 | L+ | E | 1. REPORT TO A CENTAUR INSULATION PANEL JETTISON. MARK 3. |
| 9 | L+3M | FP | 1. TRANSMIT NOMINAL (T-5) PREDICTIONS TO DSIF 51 (IF REQUIRED).<br>2. COMPLETE COMPUTATION OF INJECTION CONDITIONS.<br>3. BEGIN COMPUTATION OF NOMINAL TRAJECTORY BASED ON ANNOUNCED LAUNCH TIME (94 X, Y). |
| 10 | L+ | E | 1. REPORT TO A S/C NOSE FAIRING JETTISON. MARK 4. |
| 11 | L+ | E | 1. REPORT TO A ATLAS SUSTAINER ENGINE CUTOFF (SECO). MARK 5. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 12 | L+ | E | 1. REPORT TO A ATLAS/CENTAUR SEPARATION. MARK 7. |
| 13 | L+ | E | 1. REPORT TO A CENTAUR MAIN ENGINE IGNITION (MEIG). MARK 8. |
| 14 | L+6M9S | E | 1. REPORT TO A RECEPTION OF S/C T/M (VHF) FROM AFETR 9.1.<br>2. SWITCH TO AFETR 9.1 T/M FOR TRANSMISSION TO SF. |
| 15 | L+7M | E | 1. REPORT TO A LOSS OF SIGNAL BY AFETR TEL II. |
| 16 | L+10M39S | E | 1. REPORT TO A RECEPTION OF S/C T/M (VHF) FROM AFETR SHIP.<br>2. SWITCH TO SHIP T/M FOR TRANSMISSION TO SF. |
| 17 | L+11M=I | E | 1. REPORT TO A CENTAUR MAIN ENGINE CUTOFF (MECO). MARK 9=INJECTION. (TIME OF INJECTION IS VARIABLE. TIMES GIVEN FOR SUBSEQUENT MARK EVENTS ARE BASED ON INJECTION AT L+11M). |
| 18 | I+38S | E | 1. REPORT TO A SURVEYOR LANDING GEAR EXTEND COMMAND SENT. MARK 13. |
| 19 | I+49S | E | 1. REPORT TO A SURVEYOR OMNIANTENNAS EXTEND COMMAND SENT. MARK 14. |
| 20 | I+1M | E | 1. REPORT TO A LOSS OF SIGNAL BY AFETR 9.1. |
| 21 | I+1M | IPP | 1. BEGIN TRANSMISSION OF RAW AFETR TRACKING DATA TO SF. |
| 22 | I+1M09S | E | 1. REPORT TO A SURVEYOR HIGH-POWER TRANSMITTER ON. MARK 15.<br>2. AFETR STATIONS SWITCH TO S/C S-BAND T/M FOR TRANSMISSION TO E. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 22 | (CONTINUED) | | 3. REPORT TO A S-BAND SIGNAL ACQUISITION BY SHIP. |
| 23 | I+1M15S | E | 1. REPORT TO A CENTAUR/SURVEYOR ELECTRICAL DISCONNECT. MARK 16. |
| 24 | I+1M20S | E | 1. REPORT TO A CENTAUR/SURVEYOR SEPARATION. MARK 17. |
| 25 | I+2M | FP | 1. REPORT TO A COMPLETION OF NOMINAL TRAJECTORY COMPUTATION. |
| 26 | I+2M | IPP | 1. REPORT TO A START OF COMPUTATION OF INJECTION CONDITIONS. |
| 27 | I+5M28S | E | 1. REPORT TO A CENTAUR AND S/C ON AFETR 12 HORIZON. |
| 28 | I+6M | SP | 1. REPORT TO DSIF 51 LANDING GEAR, OMNIS, HIGH-POWER, SEPARATION STATUS. |
| 29 | I+6M | IPP | 1. REPORT TO A COMPLETION OF INJECTION CONDITIONS AND ORBITAL ELEMENTS COMPUTATION.<br>2. REPORT TO A START OF COMPUTATION OF PREDICTIONS FOR DSIF 51.<br>3. TRANSMIT INJECTION CONDITIONS AND ORBITAL ELEMENTS TO SF. |
| 30 | I+7M | IPP | 1. BEGIN TRANSMITTING PREDICTIONS FOR DSIF 51 TO SF. |
| 31 | I+7M | COMM | 1. BEGIN RETRANSMITTING IPP PREDICTIONS TO DSIF 51. |
| 32 | I+8M | E | 1. REPORT TO A CENTAUR ACQUISITION BY AFETR 12.<br>2. REPORT TO A S/C S-BAND ACQUISITION BY AFETR 12.<br>3. SWITCH TO AFETR 12 S/C T/M FOR TRANSMISSION TO SF. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 33 | I+9M | IPP | 1. START TRANSMITTING RAW TRACKING DATA FROM AFETR 12 TO SF. |
| 34 | I+10M | FP | 1. REPORT TO A DECISION ON USE OF AFETR PREDICTIONS AT DSIF 51. |
| 35 | I+12M12S | 51 | 1. VISIBILITY BEGINS. |
| 36 | I+12M12S | NET | 1. REPORT START OF SEARCH FOR S/C BY DSIF 51. |
| 37 | I+13M30S | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 51. |
| 38 | I+15M | NET | 1. REPORT TO A DSIF 51 IN ONE-WAY LOCK WITH S/C. |
| 39 | I+15M | FP | 1. REPORT TO A START OF FIRST ORBIT DETERMINATION (94 X, Y). |
| 40 | I+17M | IPP | 1. REPORT TO A COMPLETION OF TRANSMISSION TO SF OF PREDICTIONS FOR DSIF 51. |
| 41 | I+17M30S | E | 1. REPORT TO A CENTAUR RETRO START. MARK 18. |
| 42 | I+19M | NET | 1. REPORT TO A DSIF 51 IN TWO-WAY LOCK WITH S/C. |
| 43 | I+19M | 51 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 44 | I+19M | IPP | 1. COMPLETE TRANSMISSION OF RAW AFETR TRACKING DATA TO SF.<br>2. REPORT TO A START OF MULTIPLE STATION ORBIT COMPUTATION. |
| 45 | I+20M | SP | 1. REPORT SOLAR PANEL ERECTED.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2050 (PRE-SUN S/C PREPARATION AND BIT RATE SELECTION). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 46 | I+20M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2050. |
| 47 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2050. DSIF 51 WILL EXECUTE EACH MINOR SEQUENCE IN 2050 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 48 | I+21M | 51 | 1. EXECUTE COMMAND SEQUENCE 0040 (COAST TO COMM. 1/ACCELEROMETER OFF). |
| 49 | I+24M | 51 | 1. EXECUTE COMMAND SEQUENCE 0041 (INITIAL 4400 BPS SELECTION). |
| 50 | I+26M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2050, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2051 (SUN ACQUISITION). |
| 51 | I+26M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2051. |
| 52 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2051. DSIF 51 WILL EXECUTE EACH MINOR SEQUENCE IN 2051 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 53 | I+27M | 51 | 1. EXECUTE COMMAND SEQUENCE 0042 (SUN ACQUISITION MODE). |
| 54 | I+34M | IPP | 1. REPORT COMPLETION OF MULTIPLE STATION ORBIT COMPUTATION.<br>2. TRANSMIT INJECTION CONDITIONS TO SF. |
| 55 | I+40M | FP | 1. BRIEF A ON STATUS OF AFETR AND INCOMING DSIF TRACKING DATA. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 56 | I+40M | SP | 1. REPORT TO A SUN ACQUIRED. |
| | | | 2. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 57 | I+40M | 51 | 1. EXECUTE COMMAND SEQUENCE 0043 (POST MANEUVER COMM.4 SELECTION). |
| 58 | I+42M | 51 | 1. EXECUTE COMMAND SEQUENCE 0044 (COMM. 2 SELECTION). |
| 59 | I+42M | IPP | 1. REPORT TO A START OF CENTAUR ORBITAL ELEMENTS COMPUTATION. |
| 60 | I+44M | 51 | 1. EXECUTE COMMAND SEQUENCE 0045 (COMM. 3 SELECTION). |
| 61 | I+45M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2051, AND STATUS OF S/C RESPONSE. |
| | | | 2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2052 (COAST PHASE PREPARATION-1100BPS). |
| 62 | I+45M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2052. |
| 63 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2052. DSIF 51 WILL EXECUTE EACH MINOR SEQUENCE IN 2052 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 64 | I+46M | 51 | 1. EXECUTE COMMAND SEQUENCE 0046 (4400 TO 1100 BPS CHANGE). |
| 65 | I+46M | IPP | 1. REPORT COMPLETION OF CENTAUR ORBITAL ELEMENTS COMPUTATION. |
| | | | 2. TRANSMIT CENTAUR ORBITAL ELEMENTS TO SF. |
| 66 | I+48M | 51 | 1. EXECUTE COMMAND SEQUENCE 0047 (LOW |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 66 | (CONTINUED) | | POWER/COAST COMM.). |
| 67 | I+49M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2052, AND STATUS OF S/C RESPONSE. |
| 68 | I+1H30M | FP | 1. REPORT TO A COMPLETION OF FIRST ORBIT DETERMINATION.<br>2. BEGIN TRAJECTORY COMPUTATION (94X). |
| 69 | I+1H35M | FP | 1. TRANSMIT REVISED PREDICTIONS TO DSIF 51. |
| 70 | I+1H40M | FP | 1. COMPLETE TRAJECTORY COMPUTATION. |
| 71 | I+1H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 72 | I+1H45M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2055 (COAST PHASE BIT RATE REDUCTION - 550 FROM 4400/1100 BPS). |
| 73 | I+1H45M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2055. |
| 74 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2055. |
| 75 | I+1H46M | 51 | 1. EXECUTE COMMAND SEQUENCE 2055. |
| 76 | I+1H47M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2055, AND STATUS OF S/C RESPONSE. |
| 77 | I+2H | FP | 1. REPORT TO A START OF SECOND ORBIT DETERMINATION (INITIAL CONDITION EVALUATION) (94X, Y). |
| 78 | I+2H30M | FP | 1. REPORT TO A COMPLETION OF SECOND ORBIT DETERMINATION.<br>2. BEGIN TRAJECTORY COMPUTATION (94X). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 79 | I+2H40M | FP | 1. COMPLETE TRAJECTORY COMPUTATION.<br>2. GENERATE TELECOMMUNICATIONS SAVE TAPE FOR SP. |
| 80 | I+2H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE, AND TELECOMMUNICATIONS PROGRAM RUN. |
| 81 | I+3H | FP | 1. REPORT TO A START OF THIRD ORBIT DETERMINATION (PRELIMINARY MIDCOURSE ORBIT) (94X, Y). |
| 82 | I+3H15M | SP | 1. BRIEF A ON RESULTS OF TELECOMMUNICATIONS PROGRAM RUN. |
| 83 | I+3H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 84 | I+4H | FP | 1. REPORT TO A COMPLETION OF THIRD ORBIT DETERMINATION.<br>2. BEGIN TRAJECTORY COMPUTATION (94X). |
| 85 | I+4H05M | FP | 1. TRANSMIT PREDICTIONS TO DSIF 51, 11, 42. |
| 86 | I+4H10M | FP | 1. COMPLETE TRAJECTORY COMPUTATION.<br>2. REPORT TO A START OF PRELIMINARY MIDCOURSE COMPUTATION (94X, Y). |
| 87 | I+4H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 88 | I+4H55M | FP | 1. REPORT TO A COMPLETION OF PRELIMINARY MIDCOURSE COMPUTATION. |
| 89 | I+4H55M | SP | 1. REPORT TO A START OF POWER, THERMAL PREDICTION COMPUTATION. |
| 90 | I+5H10M | FP | 1. GIVE PRELIMINARY M/C CORRECTION DATA TO SP.<br>2. BRIEF A ON RESULTS OF PRELIMINARY M/C |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 90 | (CONTINUED) | | STUDY. |
| 91 | I+5H20M | FP | 1. REPORT TO A START OF FOURTH ORBIT DETERMINATION (DATA CONSISTENCY ORBIT) (94X, Y). |
| 92 | I+5H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 93 | I+5H50M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2056 (HIGH-POWER ENGINEERING INTERROGATION - 4400 BPS FROM 550 BPS). |
| 94 | I+5H50M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2056. |
| 95 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2056. DSIF 51 WILL EXECUTE EACH MINOR SEQUENCE IN 2056 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 96 | I+5H51M | 51 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 97 | I+5H51M45S | 51 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| | I+5H53M | 51 | 1. EXECUTE COMMAND SEQUENCE 0143 (HIGH-POWER/550 TO 4400 BPS CHANGE). |
| 98 | I+5H56M | 51 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 99 | I+5H58M | 51 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 100 | I+6H | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2056, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2150 (STAR VERIFI- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 100 | (CONTINUED) | | CATION/ACQUISITION-TRANSPONDER OFF, TWO ROTATIONS). |
| | | | 3. BRIEF A ON RESULTS OF POWER, THERMAL PREDICTION COMPUTATION. |
| 101 | I+6H00M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2150. |
| 102 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2150. DSIF 51 WILL EXECUTE EACH MINOR SEQUENCE IN 2150 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 103 | I+6H01M | 51 | 1. EXECUTE COMMAND SEQUENCE 0146 (TRANSPONDER OFF/DSIF REACQUISITION). |
| 104 | I+6H03M | SP | 1. REPORT TO A DSIF REACQUISITION. |
| 105 | I+6H03M | 51 | 1. EXECUTE COMMAND SEQUENCE 0147 (STAR MANEUVER PREPARATION). |
| 106 | I+6H04M | 51 | 1. EXECUTE COMMAND SEQUENCE 0240 (ROLL). |
| 107 | I+6H16M | 51 | 1. EXECUTE COMMAND SEQUENCE 0241 (SELECT OMNI A). |
| 108 | I+6H28M | 51 | 1. EXECUTE COMMAND SEQUENCE 0243. (SUN AND STAR MODE). |
| 109 | I+6H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 110 | I+6H42M | SP | 1. REPORT TO A CANOPUS ACQUIRED. |
| 111 | I+6H42M | 51 | 1. EXECUTE COMMAND SEQUENCE 0244 (CRUISE MODE). |
| 112 | I+6H43M | 51 | 1. EXECUTE COMMAND SEQUENCE 0245 (TRANSPONDER ON/DSIF REACQUISITION). |
| 113 | I+6H45M | SP | 1. REPORT TO A DSIF REACQUISITION. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 113 | (CONTINUED) | | 2. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2150, AND STATUS OF S/C RESPONSE. |
| | | | 3. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2053 (COAST PHASE PREPARATION - 137.5 BPS). |
| 114 | I+6H45M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2053. |
| 115 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2053. DSIF 51 WILL EXECUTE EACH MINOR SEQUENCE IN 2053 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 116 | I+6H46M | 51 | 1. EXECUTE COMMAND SEQUENCE 0246 (HIGH RATE TO 137.5 BPS CHANGE). |
| 117 | I+6H48M | 51 | 1. EXECUTE COMMAND SEQUENCE 0047 (LOW POWER/COAST COMM.). |
| 118 | I+6H49M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2053 AND STATUS OF S/C RESPONSE. |
| 119 | I+7H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 120 | I+8H20M | FP | 1. REPORT TO A COMPLETION OF FOURTH ORBIT DETERMINATION. |
| | | | 2. REPORT TO A START OF INTERMEDIATE M/C COMPUTATION (94X, Y). |
| 121 | I+8H30M | FP | 1. BRIEF A ON RESULTS OF FOURTH ORBIT. |
| 122 | I+8H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 123 | I+9H05M | FP | 1. REPORT TO A COMPLETION OF INTERMEDIATE M/C COMPUTATIONS. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 124 | I+9H20M | FP | 1. GIVE INTERMEDIATE M/C CORRECTION DATA TO SP.<br>2. BRIEF A ON RESULTS OF INTERMEDIATE M/C STUDY.<br>3. BEGIN TRAJECTORY COMPUTATION (94X). |
| 125 | I+9H30M | FP | 1. COMPLETE TRAJECTORY COMPUTATION. |
| 126 | I+9H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 127 | I+10H39M | 51 | 1. VISIBILITY ENDS. |
| 128 | I+10H40M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 129 | I+10H42M | 11 | 1. VISIBILITY BEGINS. |
| 130 | I+10H42M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 11. |
| 131 | I+10H44M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 11. |
| 132 | I+10H46M | NET | 1. REPORT TO A DSIF 11 IN ONE-WAY LOCK WITH S/C. |
| 133 | I+10H52M | NET | 1. REPORT TO A DSIF 11 IN TWO-WAY LOCK WITH S/C. |
| 134 | I+10H52M | 11 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 135 | I+11H | FP | 1. REPORT TO A START OF FIFTH ORBIT DETERMINATION (94X, Y). |
| 136 | I+12H29M | SP | 1. REPORT TO A DECSION TO EXECUTE COMMAND SEQUENCE 2057 (HIGH-POWER ENGINEERING INTERROGATION-4400 BPS FROM 137.5, 17.2). |
| 137 | I+12H29M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2057. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 138 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2057. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2057 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 139 | I+12H30M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 140 | I+12H30M | FP | 1. REPORT TO A COMPLETION OF FIFTH ORBIT DETERMINATION.<br>2. REPORT TO A START OF FINAL M/C MANEUVER COMPUTATION (94X, Y). |
| 141 | I+12H30M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 142 | I+12H32M | 11 | 1. EXECUTE COMMAND SEQUENCE 0247 (HIGH POWER/LOW RATE TO 4400 BPS). |
| 143 | I+12H35M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 144 | I+12H37M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 145 | I+12H39M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2057, AND STATUS OF S/C RESPONSE. |
| 146 | I+12H50M | FP | 1. REPORT TO A COMPLETION OF FINAL MIDCOURSE MANEUVER COMPUTATION.<br>2. BEGIN TRAJECTORY COMPUTATION BASED ON NOMINAL MIDCOURSE MANEUVER (94X). |
| 147 | I+13H | FP | 1. COMPLETE TRAJECTORY COMPUTATION BASED ON NOMINAL MIDCOURSE MANEUVER. |
| 148 | I+13H | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 149 | I+13H10M | FP | 1. MIDCOURSE MANEUVER COMMAND DE- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 149 | (CONTINUED) | | CISION I. |
| 150 | I+13H25M | SP | 1. MIDCOURSE MANEUVER COMMAND DECISION II. |
| 151 | I+13H29M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2057 (HIGH-POWER ENGINEERING INTERROGATION - 4400 BPS FROM 137.5, 17.2). |
| 152 | I+13H29M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2057. |
| 153 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2057. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2057 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 154 | I+13H30M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 155 | I+13H30M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 156 | I+13H32M | 11 | 1. EXECUTE COMMAND SEQUENCE 0247 (HIGH POWER/LOW RATE TO 4400 BPS). |
| 157 | I+13H35M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 158 | I+13H35M | SP | 1. REPORT TO A COMPLETION OF MIDCOURSE MANEUVER COMMAND MESSAGE PREPARATION. |
| 159 | I+13H35M | SP,FP | 1. START VALIDATION OF MIDCOURSE MANEUVER COMMAND MESSAGE. |
| 160 | I+13H37M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 161 | I+13H39M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2057, AND STATUS OF S/C RESPONSE. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 161 | (CONTINUED) | | 2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2151 (EARLY GYRO SPEED CHECK). |
| 162 | I+13H39M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2151. |
| 163 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2151. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2151 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 164 | I+13H40M | 11 | 1. EXECUTE COMMAND SEQUENCE 0340 (ENGINEERING COMM. OFF). |
| 165 | I+13H40M | SP | 1. SEND TO A MIDCOURSE MANEUVER COMMAND REQUEST. |
| 166 | I+13H41M | 11 | 1. EXECUTE COMMAND SEQUENCE 0341 (SCO TO GYRO PROCESSING). |
| 167 | I+13H42M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 168 | I+13H42M | A | 1. COMMAND DIRECTIVE - SEND MIDCOURSE MANEUVER COMMAND MESSAGE TO DSIF 11. |
| 169 | I+13H43M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 170 | I+13H44M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 171 | I+13H45M | 11 | 1. EXECUTE COMMAND SEQUENCE 0343 (GYRO PROCESSING OFF). |
| | | | 2. COMMAND VERIFICATION - PLAYBACK MIDCOURSE MANEUVER COMMAND TAPE FOR VERIFICATION. |
| 172 | I+13H46M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2151, AND STATUS OF S/C RESPONSE. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 172 | (CONTINUED) | | 2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2152 (POST GYRO CHECK COAST PHASE PREPARATION-137.5 BPS). |
| 173 | I+13H46M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2152. |
| 174 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2152. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2152 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 175 | I+13H47M | 11 | 1. EXECUTE COMMAND SEQUENCE 0344 (137.5 BPS SELECTION). |
| 176 | I+13H48M | 11 | 1. EXECUTE COMMAND SEQUENCE 0345 (LOW POWER/COAST COMM.). |
| 177 | I+13H49M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2152, AND STATUS OF S/C RESPONSE. |
| 178 | I+14H | SP | 1. REPORT TO A COMPLETION OF M/C MANEUVER COMMAND TAPE VERIFICATION. |
| 179 | I+14H | FP | 1. REPORT TO A START OF MIDCOURSE PREDICTION ORBIT DETERMINATION (94X). |
| 180 | I+14H17M | 42 | 1. VISIBILITY BEGINS. |
| 181 | I+14H17M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 42. |
| 182 | I+14H18M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 42. |
| 183 | I+14H20M | NET | 1. REPORT TO A DSIF 42 IN ONE-WAY LOCK WITH S/C. |
| 184 | I+14H26M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2057 (HIGH-POWER ENGINEERING INTERROGATION-4400 BPS FROM 137.5, 17.2). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 185 | I+14H26M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2057. |
| 186 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2057. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2057 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 187 | I+14H27M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 188 | I+14H27M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 189 | I+14H29M | 11 | 1. EXECUTE COMMAND SEQUENCE 0247 (HIGH POWER/LOW RATE TO 4400 BPS). |
| 190 | I+14H30M | FP | 1. REPORT TO A COMPLETION OF MIDCOURSE PREDICTION ORBIT DETERMINATION. |
| 191 | I+14H32M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 192 | I+14H34M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 193 | I+14H36M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2057, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2154 (LATE GYRO SPEED CHECK/4400 BPS RETURN). |
| 194 | I+14H36M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2154. |
| 195 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2154. DSIF 11 WILL EXECUTE EACH MINOR COMMAND SEQUENCE IN 2154 ON DIRECTION OF SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 196 | I+14H37M | 11 | 1. EXECUTE COMMAND SEQUENCE 0341 (SCO TO GYRO PROCESSING). |
| 197 | I+14H38M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 198 | I+14H39M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 199 | I+14H40M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 200 | I+14H40M | FP | 1. TRANSMIT PREDICTIONS BASED ON NOMINAL MIDCOURSE MANEUVER TO DSIF 51, 42, 11. |
| 201 | I+14H41M | 11 | 1. EXECUTE COMMAND SEQUENCE 0346 (GYRO PROCESSING TO 33 KC SCO). |
| 202 | I+14H42M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2154, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2155 (MIDCOURSE CORRECTION PREPARATION). |
| 203 | I+14H42M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2155. |
| 204 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2155. DSIF 11 WILL EXECUTE EACH MINOR COMMAND SEQUENCE IN 2155 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 205 | I+14H43M | 11 | 1. EXECUTE COMMAND SEQUENCE 0347 (PRE-M/C THRUST PREPARATION). |
| 206 | I+14H44M | 11 | 1. EXECUTE COMMAND SEQUENCE 0440 (PRE-M/C ROLL PARAMETERS). |
| 207 | I+14H45M | 11 | 1. EXECUTE COMMAND SEQUENCE 0441 (SUN |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 207 | (CONTINUED) | | AND ROLL). |
| 208 | I+14H46M30S | SP | 1. REPORT TO A COMPLETION OF ROLL MANEUVER. |
| 209 | I+14H47M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0442 (PRE-M/C YAW (PITCH) PARAMETERS). |
| 210 | I+14H48M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0443 (0444) (YAW(PITCH)). |
| 211 | I+14H54M50S | SP | 1. REPORT TO A COMPLETION OF YAW (PITCH) MANEUVER. |
| 212 | I+14H55M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0445 (RESET SET IV LATCH). |
| 213 | I+14H56M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0446 (THRUST PHASE POWER). |
| 214 | I+14H57M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0447 (STRAIN GAUGES/M/C THRUST PARAMETERS). |
| 215 | I+14H58M50S | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2155, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2156 (MIDCOURSE THRUST EXECUTION). |
| 216 | I+14H59M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2156. |
| 217 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2156. |
| 218 | I+15H | 11 | 1. EXECUTE COMMAND SEQUENCE 2156. |
| 219 | I+15H | FP | 1. COMPARE PREDICTED AND OBSERVED DOPPLER SHIFTS IN REAL TIME DURING MIDCOURSE EXECUTION. |
| 220 | I+15H01M | SP | 1. REPORT TO A COMPLETION OF EXECUTION |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 220 | (CONTINUED) | | OF COMMAND SEQUENCE 2156, AND STATUS OF S/C RESPONSE. |
| | | | 2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2157 (POST-M/C SPACECRAFT RETURN TO COAST). |
| 221 | I+15H01M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2157. |
| 222 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2157. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2157 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF 11 EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 223 | I+15H02M | 11 | 1. EXECUTE COMMAND SEQUENCE 0540. |
| 224 | I+15H03M | 11 | 1. EXECUTE COMMAND SEQUENCE 0541 (POST-M/C YAW (PITCH) PARAMETERS). |
| 225 | I+15H04M | 11 | 1. EXECUTE COMMAND SEQUENCE 0443 (0444) (YAW (PITCH)). |
| 226 | I+15H10M | SP | 1. REPORT TO A COMPLETION OF YAW (PITCH) MANEUVER. |
| 227 | I+15H11M | 11 | 1. EXECUTE COMMAND SEQUENCE 0542 (POST-M/C ROLL PARAMETERS/VERNIER PURGE TERMINATION). |
| 228 | I+15H12M | 11 | 1. EXECUTE COMMAND SEQUENCE 0441 (SUN AND ROLL). |
| 229 | I+15H13M30S | SP | 1. REPORT TO A COMPLETION OF ROLL MANEUVER. |
| 230 | I+15H13M30S | 11 | 1. EXECUTE COMMAND SEQUENCE 0243 (SUN AND STAR MODE). |
| 231 | I+15H15M | 11 | 1. EXECUTE COMMAND SEQUENCE 0543 (POST-MANEUVER COMM. 2 SELECTION). |
| 232 | I+15H17M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 232 | (CONTINUED) | | 4 SELECTION). |
| 233 | I+15H19M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2157, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2054. (COAST PHASE PREPARATION-17.2 BPS). |
| 234 | I+15H19M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2054. |
| 235 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2054. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2054 ON DIRECTION OF SP. NOMINAL TIMES FOR DSIF 11 EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 236 | I+15H20M | 11 | 1. EXECUTE COMMAND SEQUENCE 0544 (4400/1100 TO 17.2 BPS CHANGE). |
| 237 | I+15H22M | 11 | 1. EXECUTE COMMAND SEQUENCE 0047 (LOW POWER/COAST COMM.). |
| 238 | I+15H23M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2054 AND STATUS OF S/C RESPONSE. |
| 239 | I+15H30M | FP | 1. BRIEF SFOD ON INITIAL EVALUATION OF MIDCOURSE MANEUVER. |
| 240 | I+15H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 241 | I+16H | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 242 | I+16H5M | NET | 1. REPORT TO A DSIF 11 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 243 | I+16H6M | NET | 1. REPORT TO A DSIF 42 IN TWO-WAY LOCK WITH S/C. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 244 | I+16H6M | 42 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 245 | I+16H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 246 | I+17H | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 247 | I+17H05M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 248 | I+17H06M | NET | 1. REPORT TO A DSIF 11 IN TWO-WAY LOCK WITH S/C. |
| 249 | I+17H06M | 11 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 250 | I+17H30M | SP | 1. REPORT TO A START OF POWER THERMAL PROGRAM UPDATE, AND POWER THERMAL PREDICTION COMPUTATION.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2250 (HIGH POWER BEFORE STAR VERIFICATION). |
| 251 | I+17H30M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2250. |
| 252 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2250. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2250 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF 11 EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 253 | I+17H31M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 254 | I+17H31M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0545 (COAST TO COMM. 1). |
| 255 | I+17H33M | 11 | 1. EXECUTE COMMAND SEQUENCE 0247 (HIGH POWER/LOW RATE TO 4400 BPS). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 256 | I+17H34M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2250, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2150 (STAR VERIFICATION/ACQUISITION - TRANSPONDER OFF, TWO ROTATIONS). |
| 257 | I+17H34M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2150. |
| 258 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2150. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2150 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 259 | I+17H35M | 11 | 1. EXECUTE COMMAND SEQUENCE 0146 (TRANSPONDER OFF/DSIF REACQUISITION). |
| 260 | I+17H37M | SP | 1. REPORT TO A DSIF REACQUISITION. |
| 261 | I+17H37M | 11 | 1. EXECUTE COMMAND SEQUENCE 0147 (STAR MANEUVER PREPARATION). |
| 262 | I+17H38M | 11 | 1. EXECUTE COMMAND SEQUENCE 0240 (ROLL). |
| 263 | I+17H50M | 11 | 1. EXECUTE COMMAND SEQUENCE 0241 (SELECT OMNI A). |
| 264 | I+18H02M | 11 | 1. EXECUTE COMMAND SEQUENCE 0243 (SUN AND STAR MODE). |
| 265 | I+18H16M | SP | 1. REPORT TO A CANOPUS ACQUIRED. |
| 266 | I+18H16M | 11 | 1. EXECUTE COMMAND SEQUENCE 0244 (CRUISE MODE). |
| 267 | I+18H17M | 11 | 1. EXECUTE COMMAND SEQUENCE 0245 (TRANSPONDER ON/DSIF REACQUISITION). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 268 | I+18H19M | SP | 1. REPORT TO A DSIF REACQUISITION.<br>2. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2150, AND STATUS OF S/C RESPONSE.<br>3. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2054 (COAST PHASE PREPARATION-17.2 BPS). |
| 269 | I+18H19M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2054. |
| 270 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2054. DSIF 11 WILL EXECUTE EACH MINOR SEQUENCE IN 2054 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 271 | I+18H20M | 11 | 1. EXECUTE COMMAND SEQUENCE 0544 (4400/1100 TO 17.2 BPS). |
| 272 | I+18H22M | 11 | 1. EXECUTE COMMAND SEQUENCE 0047 (LOW POWER/COAST COMM.). |
| 273 | I+18H23M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2054, AND STATUS OF S/C RESPONSE. |
| 274 | I+18H25M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 275 | I+18H30M | NET | 1. REPORT TO A DSIF 11 TRANSMITTER OFF AND S/C TRACKING STOPPED. |
| 276 | I+18H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 277 | I+18H31M | NET | 1. REPORT TO A DSIF 42 IN TWO-WAY LOCK WITH S/C. |
| 278 | I+18H31M | 42 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 279 | I+18H49M | 11 | 1. VISIBILITY ENDS. |
| 280 | I+19H | SP | 1. BRIEF A ON RESULTS OF POWER, THERMAL PREDICTION COMPUTATION. |
| 281 | I+19H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 282 | I+20H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 283 | I+21H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 284 | I+22H | FP | 1. REPORT TO A START OF FIRST POST-MIDCOURSE ORBIT DETERMINATION (94X). |
| 285 | I+22H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 286 | I+23H23M | 51 | 1. VISIBILITY BEGINS. |
| 287 | I+23H23M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 51. |
| 288 | I+23H24M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 51. |
| 289 | I+23H26M | NET | 1. REPORT TO A DSIF 51 IN ONE-WAY LOCK WITH S/C. |
| 290 | I+23H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 291 | I+24H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 292 | I+24H40M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 293 | I+24H45M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 294 | I+24H46M | NET | 1. REPORT TO A DSIF 51 IN TWO-WAY LOCK WITH S/C. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 295 | I+24H46M | 51 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 296 | I+25H | FP | 1. REPORT TO A COMPLETION OF FIRST POSTMIDCOURSE ORBIT DETERMINATION. |
| | | | 2. BEGIN TRAJECTORY COMPUTATION (94X). |
| 297 | I+25H05M | FP | 1. TRANSMIT PREDICTIONS TO DSIF 51, 11, 42. |
| 298 | I+25H10M | FP | 1. COMPLETE TRAJECTORY COMPUTATION. |
| | | | 2. GENERATE TELECOMMUNICATIONS SAVE TAPE FOR SP. |
| 299 | I+25H15M | FP | 1. BRIEF A ON FIRST POSTMIDCOURSE ORBIT. |
| 300 | I+25H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE, AND TELECOMMUNICATIONS PROGRAM RUN. |
| 301 | I+25H40M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2251. (LOW-POWER ENGINEERING INTERROGATION). |
| 302 | I+25H40M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2251. |
| 303 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2251. DSIF 51 WILL EXECUTE MINOR SEQUENCES IN 2251 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 304 | I+25H41M | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 305 | I+25H44M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 306 | I+25H46M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 307 | I+25H48M | 11 | 1. EXECUTE COMMAND SEQUENCE 0546 (ENGINEERING TO COAST COMM.). |
| 308 | I+25H49M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2251, AND STATUS OF S/C RESPONSE. |
| 309 | I+26H | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 310 | I+26H | SP | 1. BRIEF A ON RESULTS OF TELECOMMUNICATIONS PROGRAM RUN. |
| 311 | I+26H05M | NET | 1. REPORT TO A DSIF 51 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 312 | I+26H06M | NET | 1. REPORT TO A DSIF 42 IN TWO-WAY LOCK WITH S/C. |
| 313 | I+26H06M | 42 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 314 | I+26H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 315 | I+27H20M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 316 | I+27H25M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND S/C TRACKING STOPPED. |
| 317 | I+27H26M | NET | 1. REPORT TO A DSIF 51 IN TWO-WAY LOCK WITH S/C. |
| 318 | I+27H26M | 51 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 319 | I+27H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 320 | I+27H50M | 42 | 1. VISIBILITY ENDS. |
| 321 | I+28H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 322 | I+29H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 323 | I+30H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 324 | I+31H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 325 | I+32H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 326 | I+33H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 327 | I+34H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 328 | I+34H48M | 11 | 1. VISIBILITY BEGINS. |
| 329 | I+34H48M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 11. |
| 330 | I+34H49M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 11. |
| 331 | I+34H50M | NET | 1. REPORT TO A DSIF 11 IN ONE-WAY LOCK WITH S/C.<br>2. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 332 | I+34H55M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND S/C TRACKING STOPPED. |
| 333 | I+34H56M | NET | 1. REPORT TO A DSIF 11 IN TWO-WAY LOCK WITH S/C. |
| 334 | I+34H56M | 11 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 335 | I+35H19M | 51 | 1. VISIBILITY ENDS. |
| 336 | I+35H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 337 | I+36H30M | SP | 1. REPORT TO A START OF POWER THERMAL PROGRAM UPDATE, AND POWER THERMAL PREDICTION COMPUTATION. |
| 338 | I+37H | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2251 (LOW-POWER ENGINEERING INTERROGATION). |
| 339 | I+37H00M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2251. |
| 340 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2251. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2251 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 341 | I+37H01M | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 342 | I+37H04M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 343 | I+37H06M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 344 | I+37H08M | 11 | 1. EXECUTE COMMAND SEQUENCE 0546 (ENGINEERING TO COAST COMM.). |
| 345 | I+37H09M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2251, AND STATUS OF S/C RESPONSE. |
| 346 | I+37H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 347 | I+38H | SP | 1. BRIEF A ON RESULTS OF POWER,THERMAL PREDICTION COMPUTATION. |
| 348 | I+38H | FP | 1. REPORT TO A START OF SECOND POSTMIDCOURSE ORBIT DETERMINATION (94X). |
| 349 | I+38H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 350 | I+38H47M | 42 | 1. VISIBILITY BEGINS. |
| 351 | I+38H47M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 42. |
| 352 | I+38H48M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 42. |
| 353 | I+38H50M | NET | 1. REPORT TO A DSIF 42 IN ONE-WAY LOCK WITH S/C. |
| 354 | I+39H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 355 | I+40H | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 356 | I+40H05M | NET | 1. REPORT TO A DSIF 11 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 357 | I+40H06M | NET | 1. REPORT TO A DSIF 42 IN TWO-WAY LOCK WITH S/C. |
| 358 | I+40H06M | 42 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 359 | I+40H30M | SP | 1. REPORT TO A START OF POWER, THERMAL PROGRAM UPDATE. |
| 360 | I+41H | FP | 1. REPORT TO A COMPLETION OF SECOND POSTMIDCOURSE ORBIT DETERMINATION.<br>2. BEGIN TRAJECTORY COMPUTATION (94X). |
| 361 | I+41H10M | FP | 1. COMPLETE TRAJECTORY COMPUTATION.<br>2. REPORT TO A START OF PRELIMINARY TERMINAL MANEUVER COMPUTATIONS (94X). |
| 362 | I+41H25M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 363 | I+41H30M | FP | 1. REPORT TO A COMPLETION OF PRELIMINARY TERMINAL MANEUVER COMPUTA- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 363 | (CONTINUED) | | TIONS. |
| 364 | I+41H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 365 | I+41H30M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 366 | I+41H31M | NET | 1. REPORT TO A DSIF 11 IN TWO-WAY LOCK WITH S/C. |
| 367 | I+41H31M | 11 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 368 | I+42H | FP | 1. GIVE PRELIMINARY TERMINAL MANEUVER DATA TO SP, SS.<br>2. BRIEF A ON RESULTS OF SECOND POST-MIDCOURSE ORBIT AND PRELIMINARY TERMINAL MANEUVER COMPUTATIONS. |
| 369 | I+42H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 370 | I+42H45M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 371 | I+42H50M | NET | 1. REPORT TO A DSIF 11 TRANSMITTER OFF AND S/C TRACKING STOPPED. |
| 372 | I+42H51M | NET | 1. REPORT TO A DSIF 42 IN TWO-WAY LOCK WITH S/C. |
| 373 | I+42H51M | 42 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 374 | I+43H25M | 11 | 1. VISIBILITY ENDS. |
| 375 | I+43H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 376 | I+44H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 377 | I+45H | SP | 1. REPORT TO A DECISION TO EXECUTE COM- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 377 | (CONTINUED) | | MAND SEQUENCE 2252 (VERNIER THERMAL CONTROL). |
| 378 | I+45H00M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2252. |
| 379 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 42 EXECUTION OF COMMAND SEQUENCE 2252. |
| 380 | I+45H01M | 42 | 1. EXECUTE COMMAND SEQUENCE 2252. |
| 381 | I+45H02M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2252, AND STATUS OF S/C RESPONSE. |
| 382 | I+45H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 383 | I+46H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 384 | I+47H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 385 | I+47H34M | 51 | 1. VISIBILITY BEGINS. |
| 386 | I+47H34M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 51. |
| 387 | I+47H35M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 51. |
| 388 | I+47H37M | NET | 1. REPORT TO A DSIF 51 IN ONE-WAY LOCK WITH S/C. |
| 389 | I+48H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 390 | I+48H50M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 391 | I+48H55M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND ONE-WAY LOCK WITH S/C. |
| 392 | I+48H56M | NET | 1. REPORT TO A DSIF 51 IN TWO-WAY LOCK |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 392 | (CONTINUED) | | WITH S/C. |
| 393 | I+48H56M | 51 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 394 | I+49H | FP | 1. REPORT TO A START OF THIRD POST-MIDCOURSE ORBIT DETERMINATION (94X). |
| 395 | I+49H | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2251 (LOW-POWER ENGINEERING INTERROGATION). |
| 396 | I+49H00M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2251. |
| 397 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2251. DSIF 51 WILL EXECUTE MINOR SEQUENCES IN 2251 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 398 | I+49H01M | 51 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 399 | I+49H04M | 51 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 400 | I+49H06M | 51 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 401 | I+49H08M | 51 | 1. EXECUTE COMMAND SEQUENCE 0546 (ENGINEERING TO COAST COMM.). |
| 402 | I+49H09M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2251, AND STATUS OF S/C RESPONSE. |
| 403 | I+49H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 404 | I+50H10M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 405 | I+50H15M | NET | 1. REPORT TO A DSIF 51 TRANSMITTER OFF |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 405 | (CONTINUED) | | AND ONE-WAY LOCK WITH S/C. |
| 406 | I+50H16M | NET | 1. REPORT TO A DSIF 42 IN TWO-WAY LOCK WITH S/C. |
| 407 | I+50H16M | 42 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 408 | I+50H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 409 | I+51H30M | NET | 1. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 410 | I+51H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 411 | I+51H35M | NET | 1. REPORT TO A DSIF 42 TRANSMITTER OFF AND SPACECRAFT TRACKING STOPPED. |
| 412 | I+51H36M | NET | 1. REPORT TO A DSIF 51 IN TWO-WAY LOCK WITH S/C. |
| 413 | I+51H36M | 51 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 414 | I+51H57M | 42 | 1. VISIBILITY ENDS. |
| 415 | I+52H | FP | 1. REPORT TO A COMPLETION OF THIRD POST MIDCOURSE ORBIT DETERMINATION.<br>2. BEGIN TRAJECTORY COMPUTATION (94X). |
| 416 | I+52H10M | FP | 1. COMPLETE TRAJECTORY COMPUTATION.<br>2. REPORT TO A START OF INTERMEDIATE TERMINAL MANEUVER COMPUTATIONS (94X). |
| 417 | I+52H30M | FP | 1. REPORT TO A COMPLETION OF INTERMEDIATE TERMINAL MANEUVER COMPUTATIONS. |
| 418 | I+52H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 419 | I+53H | FP | 1. GIVE INTERMEDIATE TERMINAL MANEUVER DATA TO SP, SS. |
| | | | 2. BRIEF SFOD ON RESULTS OF INTERMEDIATE TERMINAL MANEUVER COMPUTATIONS. |
| 420 | I+53H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 421 | I+54H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 422 | I+55H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 423 | I+56H30M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 424 | I+57H | FP | 1. REPORT TO A START OF FOURTH POST-MIDCOURSE ORBIT DETERMINATION (94X, Y). |
| 425 | I+57H40M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2253 (SURVEY CAMERA WARMUP). |
| 426 | I+57H40M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2253. |
| 427 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2253. |
| 428 | I+57H41M | 51 | 1. EXECUTE COMMAND SEQUENCE 2253. |
| 429 | I+57H42M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2253, AND STATUS OF S/C RESPONSE. |
| 430 | I+58H40M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2254 (APPROACH CAMERA WARMUP). |
| 431 | I+58H40M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2254. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 432 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 51 EXECUTION OF COMMAND SEQUENCE 2254. |
| 433 | I+58H41M | 51 | 1. EXECUTE COMMAND SEQUENCE 2254. |
| 434 | I+58H42M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2254, AND STATUS OF S/C RESPONSE. |
| 435 | I+58H46M | 11 | 1. VISIBILITY BEGINS. |
| 436 | I+58H46M | NET | 1. REPORT TO A START OF SEARCH FOR S/C BY DSIF 11. |
| 437 | I+58H47M | NET | 1. REPORT TO A DETECTION OF S/C BY DSIF 11. |
| 438 | I+58H49M | NET | 1. REPORT TO A DSIF 11 IN ONE-WAY LOCK WITH S/C.<br>2. REPORT TO A START OF STATION TRANSFER PROCEDURE. |
| 439 | I+58H54M | NET | 1. REPORT TO A DSIF 51 TRANSMITTER OFF AND S/C TRACKING STOPPED. |
| 440 | I+58H55M | NET | 1. REPORT TO A DSIF 11 IN TWO-WAY LOCK WITH S/C. |
| 441 | I+58H55M | 11 | 1. BEGIN TRANSMITTING TRACKING DATA TO SF. |
| 442 | I+59H28M | 51 | 1. VISIBILITY ENDS. |
| 443 | I+59H30M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2255 (HIGH-POWER ENGINEERING INTERROGATION - AMR WARM-UP/1100 BPS FROM 137.5, 17.2). |
| 444 | I+59H30M30S | A | 1. DIRECT A TO CONTROL EXECUTION OF COMMAND SEQUENCE 2255. |
| 445 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2255. DSIF 11 WILL EXECUTE MINOR COM- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 445 | (CONTINUED) | | MAND SEQUENCES IN 2255 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 446 | I+59H31M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 447 | I+59H31M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 448 | I+59H33M | 11 | 1. EXECUTE COMMAND SEQUENCE 0547 (HIGH POWER/LOW RATE TO 1100 BPS). |
| 449 | I+59H36M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 450 | I+59H37M | 11 | 1. EXECUTE COMMAND SEQUENCE 0640. (AMR WARMUP). |
| 451 | I+59H38M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 452 | I+59H40M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2255, AND STATUS OF S/C RESPONSE. |
| 453 | I+60H | FP | 1. REPORT TO A COMPLETION OF FOURTH POSTMIDCOURSE ORBIT DETERMINATION. |
| | | | 2. REPORT TO A START OF FINAL TERMINAL MANEUVER COMPUTATION (94X, Y). |
| 454 | I+60H15M | FP | 1. REPORT TO A COMPLETION OF FINAL TERMINATION MANEUVER COMPUTATION. |
| | | | 2. BEGIN TRAJECTORY COMPUTATION (94X). |
| 455 | I+60H25M | FP | 1. COMPLETE TRAJECTORY COMPUTATION. |
| 456 | I+60H25M | SP | 1. REPORT TO A START OF POWER,THERMAL PROGRAM UPDATE. |
| 457 | I+60H30M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2256 (HIGH-POWER |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 457 | (CONTINUED) | | ENGINEERING INTERROGATION-1100 BPS FROM 137.5, 17.2). |
| 458 | I+60H30M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2256. |
| 459 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2256. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2256 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 460 | I+60H31M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 461 | I+60H31M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 462 | I+60H33M | 11 | 1. EXECUTE COMMAND SEQUENCE 0547 (HIGH POWER/LOW RATE TO 1100 BPS). |
| 463 | I+60H36M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 464 | I+60H38M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 465 | I+60H40M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2256, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2151 (EARLY GYRO SPEED CHECK). |
| 466 | I+60H40M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2151. |
| 467 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2151. DSIF 11 WILL EXECUTE MINOR COMMAND SEQUENCE IN 2151 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 468 | I+60H41M | 11 | 1. EXECUTE COMMAND SEQUENCE 0340 (ENGINEERING COMM. OFF). |
| 469 | I+60H42M | 11 | 1. EXECUTE COMMAND SEQUENCE 0341 (SCO TO GYRO PROCESSING). |
| 470 | I+60H43M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 471 | I+60H44M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 472 | I+60H45M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 473 | I+60H46M | 11 | 1. EXECUTE COMMAND SEQUENCE 0343 (GYRO PROCESSING OFF). |
| 474 | I+60H47M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2151, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2257 (VCXO AND VCO FREQUENCY CHECKS). |
| 475 | I+60H47M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2257. |
| 476 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2257. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2257 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 477 | I+60H48M | 11 | 1. EXECUTE COMMAND SEQUENCE 0146 (TRANSPONDER OFF/DSIF REACQUISITION). |
| 478 | I+60H50M | SP | 1. REPORT TO A DSIF REACQUISITION. |
| 479 | I+60H50M | 11 | 1. EXECUTE COMMAND SEQUENCE 0641 (NARROW-BAND VCXO OFF). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 480 | I+60H50M | FP | 1. TERMINAL MANEUVER COMMAND DECISION I. |
| 481 | I+60H51M | 11 | 1. EXECUTE COMMAND SEQUENCE 0642 (NARROW-BAND VCXO, TRANSPONDER ON/ DSIF REACQUISITION). |
| 482 | I+60H53M | SP | 1. REPORT TO A DSIF REACQUISITION. |
| | | | 2. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2257, AND STATUS OF S/C RESPONSE. |
| | | | 3. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2153 (POST GYRO CHECK COAST PHASE PREPARATION - 17.2 BPS). |
| 483 | I+60H53M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2153. |
| 484 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2153. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2153 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 485 | I+60H54M | 11 | 1. EXECUTE COMMAND SEQUENCE 0643 (17.2 BPS SELECTION). |
| 486 | I+60H56M | 11 | 1. EXECUTE COMMAND SEQUENCE 0345 (LOW POWER/COAST COMM.). |
| 487 | I+60H57M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2153, AND STATUS OF S/C RESPONSE. |
| 488 | I+61H05M | SP | 1. TERMINAL MANEUVER COMMAND DECISION II. |
| 489 | I+61H15M | SP | 1. REPORT TO A COMPLETION OF TERMINAL MANEUVER COMMAND MESSAGE PREPARATION. |
| 490 | I+61H15M | SP,FP | 1. START VALIDATION OF TERMINAL MANEUVER |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 490 | (CONTINUED) | | COMMAND MESSAGE. |
| 491 | I+61H20M | SP | 1. SEND TO A TERMINAL MANEUVER COMMAND REQUEST. |
| 492 | I+61H22M | A | 1. COMMAND DIRECTIVE - SEND TERMINAL MANEUVER COMMAND MESSAGE TO DSIF 11. |
| 493 | I+61H25M | 11 | 1. COMMAND VERIFICATION - PLAY BACK TERMINAL MANEUVER COMMAND TAPE FOR VERIFICATION. |
| 494 | I+61H40M | SP | 1. REPORT TO A COMPLETION OF TERMINAL MANEUVER COMMAND TAPE VERIFICATION. |
| 495 | I+61H43M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2256 (HIGH-POWER ENGINEERING INTERROGATION-1100 BPS FROM 137.5, 17.2). |
| 496 | I+61H43M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2256. |
| 497 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2256. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2256 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 498 | I+61H44M | 11 | 1. EXECUTE COMMAND SEQUENCE 0141 (TRANSMITTER B FILAMENT). |
| 499 | I+61H44M45S | 11 | 1. EXECUTE COMMAND SEQUENCE 0142 (COAST TO COMM. 2). |
| 500 | I+61H46M | 11 | 1. EXECUTE COMMAND SEQUENCE 0547 (HIGH POWER/LOW RATE TO 1100 BPS). |
| 501 | I+61H49M | 11 | 1. EXECUTE COMMAND SEQUENCE 0144 (COMM. 4 SELECTION). |
| 502 | I+61H51M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 503 | I+61H53M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2256, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2350 (LATE GYRO SPEED CHECK/1100 BPS RETURN). |
| 504 | I+61H53M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2350. |
| 505 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2350. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2350 ON DIRECTION FROM SP. NOMINAL TIMES FOR EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 506 | I+61H54M | 11 | 1. EXECUTE COMMAND SEQUENCE 0341 (SCO TO GYRO PROCESSING). |
| 507 | I+61H55M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 508 | I+61H56M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 509 | I+61H57M | 11 | 1. EXECUTE COMMAND SEQUENCE 0342 (NEXT GYRO). |
| 510 | I+61H58M | 11 | 1. EXECUTE COMMAND SEQUENCE 0644 (GYRO PROCESSING TO 7.35 KC SCO). |
| 511 | I+61H59M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2350, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2351 (PLANAR ARRAY DEPLOYMENT). |
| 512 | I+61H59M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2351. |
| 513 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 513 | (CONTINUED) | | EXECUTION OF COMMAND SEQUENCE 2351. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2351 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 514 | I+62H | 11 | 1. EXECUTE COMMAND SEQUENCE 0044 (COMM. 2 SELECTION). |
| 515 | I+62H01M | 11 | 1. EXECUTE COMMAND SEQUENCE 0645 (STEP POLAR AXIS). |
| 516 | I+62H05M | 11 | 1. EXECUTE COMMAND SEQUENCE 0145 (COMM. 1 SELECTION). |
| 517 | I+62H06M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2351, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2352 (TERMINAL MANEUVER PREPARATION). |
| 518 | I+62H06M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2352. |
| 519 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2352. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2352 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 520 | I+62H07M | 11 | 1. EXECUTE COMMAND SEQUENCE 0646 (TERMINAL FIRST ROLL PARAMETERS). |
| 521 | I+62H08M | 11 | 1. EXECUTE COMMAND SEQUENCE 0441 (SUN AND ROLL). |
| 522 | 2+62H09M30S | SP | 1. REPORT TO A COMPLETION OF ROLL MANEUVER. |
| 523 | I+62H10M | 11 | 1. EXECUTE COMMAND SEQUENCE 0641 (TERMINAL YAW (PITCH) PARAMETERS). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 524 | I+62H11M20S | 11 | 1. EXECUTE COMMAND SEQUENCE 0443 (0444) (YAW (PITCH)). |
| 525 | I+62H17M20S | SP | 1. REPORT TO A COMPLETION OF YAW (PITCH) MANEUVER. |
| 526 | I+62H17M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0740 (TERMINAL SECOND ROLL PARAMETERS). |
| 527 | I+62H18M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0240 (ROLL). |
| 528 | I+62H24M50S | SP | 1. REPORT TO A COMPLETION OF ROLL MANEUVER. |
| 529 | I+62H26M40S | 11 | 1. EXECUTE COMMAND SEQUENCE 0741 (INERTIAL MODE). |
| 530 | I+62H27M40S | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2352, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2353 (PRE-APPROACH TELECOMMUNICATIONS PREPARATION). |
| 531 | I+62H27M50S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2353. |
| 532 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2353. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2353 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 533 | I+62H28M | 11 | 1. EXECUTE COMMAND SEQUENCE 0742 (TRANSMITTER B TO PLANAR ARRAY). |
| 534 | I+62H28M10S | 11 | 1. EXECUTE COMMAND SEQUENCE 0743 (TRANSPONDER, VCXO, SUMMING AMPLIFIERS OFF). |
| 535 | I+62H29M00S | 11 | 1. EXECUTE COMMAND SEQUENCE 0744 (FREQUENCY SUMMING AMPLIFIER B). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 536 | I+62H29M10S | 11 | 1. EXECUTE COMMAND SEQUENCE 0745 (1100 TO 4400 BPS/COMM. 2 SELECTION). |
| 537 | I+62H29M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0746 (APPROACH CAMERA TEMPERATURE CONTROL OFF). |
| 538 | I+62H30M | 11 | 1. EXECUTE COMMAND SEQUENCE 0747. |
| 539 | I+62H30M10S | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2353, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2354 (FIRST APPROACH TV SEQUENCE/RETRO SEQUENCE PREPARATION). |
| 540 | I+62H30M20S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2354. |
| 541 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2354. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2354 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 542 | I+62H30M30S | 11 | 1. EXECUTE COMMAND SEQUENCE 1040 (FORTY-PICTURE TV). |
| 543 | I+62H33M20S | 11 | 1. EXECUTE COMMAND SEQUENCE 1041 (RETRO PARAMETERS). |
| 544 | I+62H34M | 11 | 1. EXECUTE COMMAND SEQUENCE 1042 (RETRO SEQUENCE MODE ON). |
| 545 | I+62H34M20S | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2354, AND STATUS OF S/C RESPONSE.<br>2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2355 (FINAL APPROACH SEQUENCE). |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 546 | I+62H34M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2355. |
| 547 | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2355. DSIF 11 WILL EXECUTE MINOR SEQUENCES IN 2355 ON DIRECTION FROM SP. NOMINAL TIMES FOR DSIF EXECUTION OF MINOR SEQUENCES ARE LISTED. |
| 548 | I+62H34M40S | 11 | 1. EXECUTE COMMAND SEQUENCE 1043 (TEN-PICTURE TV, SURVEY CAMERA TEMP-ERATURE CONTROL OFF). |
| 549 | I+62H35M30S | 11 | 1. EXECUTE COMMAND SEQUENCE 1044 (AMR POWER/RESET SET IV LATCH). |
| 550 | I+62H35M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 0446 (THREE PHASE POWER). |
| 551 | I+62H36M | 11 | 1. EXECUTE COMMAND SEQUENCE 1045 (ACCELEROMETER/STRAIN GAUGE POWER ON). |
| 552 | I+62H36M10S | 11 | 1. EXECUTE COMMAND SEQUENCE 1046 (THIRTY-PICTURE TV). |
| 553 | I+62H38M30S | 11 | 1. EXECUTE COMMAND SEQUENCE 1047 (DIS-ABLE BATTERY TRANSFER LOGIC). |
| 554 | I+62H38M40S | 11 | 1. EXECUTE COMMAND SEQUENCE 1140 (HIGH CURRENT). |
| 555 | I+62H38M50S | 11 | 1. EXECUTE COMMAND SEQUENCE I141 (TEN-PICTURE TV SEQUENCE). |
| 556 | I+62H39M50S | 11 | 1. EXECUTE COMMAND SEQUENCE 1142 (AMR ENABLE/THREE TV PICTURES/ACCELER-OMETER CHANNELS). |
| 557 | I+62H40M34S | S/C | 1. AMR TRIGGER. |
| 558 | I+62H40M43S | S/C | 1. VERNIER ENGINES IGNITED. |
| 559 | I+62H40M44S | S/C | 1. MAIN RETRO IGNITION. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 560 | I+62H40M45S | S/C | 1. DOPPLER AND ALTIMETER RADARS ON. |
| 561 | I+62H40M55S | 11 | 1. EXECUTE COMMAND SEQUENCE 1143 (TWO-PICTURE TV SEQUENCE). |
| 562 | I+62H41M42S | S/C | 1. MAIN RETRO BURNOUT. |
| 563 | I+62H41M42S | 11 | 1. EXECUTE COMMAND SEQUENCE 1144 (LAST TV) TRANSMISSION OF THIS SEQUENCE INITIATED AUTOMATICALLY BY S/C RETRO BURNOUT SIGNAL. |
| 564 | I+62H41M51S | S/C | 1. MAIN RETRO EJECTED SIGNAL. |
| 565 | I+62H42M | 11 | 1. EXECUTE COMMAND SEQUENCE 1145 (TELECOMMUNICATIONS TRANSFER). |
| 566 | I+62H43M18S | S/C | 1. 1000-FOOT MARK. |
| 567 | I+62H43M46S | S/C | 1. 10FT/SEC MARK. |
| 568 | I+62H43M54S | S/C | 1. 13-FOOT MARK. |
| 569 | I+62H43M56S | S/C | 1. TOUCHDOWN. |
| 570 | TD+0 | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2356 (POSTLANDING OPERATIONS SEQUENCE). |
| | | | 2. REPORT TO A START OF POSTLANDING ATTITUDE COMPUTATION. |
| 571 | TD+30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2356. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2356. |
| 572 | TD+1M | 11 | 1. EXECUTE COMMAND SEQUENCE 2356. |
| 573 | TD+5M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2356, AND STATUS OF S/C RESPONSE. |
| | | | 2. REPORT TO A DECISION TO EXECUTE COM- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 573 | (CONTINUED) | | MAND SEQUENCE 2357 (TOUCHDOWN SURVIVAL EVALUATION). |
| 574 | TD+5M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2357. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2357. |
| 575 | TD+6M | 11 | 1. EXECUTE COMMAND SEQUENCE 2357. |
| 576 | TD+18M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2357, AND STATUS OF S/C RESPONSE. |
| | | | 2. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2450 (SUN/ EARTH ACQUISITION). |
| 577 | TD+18M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2450. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2450. |
| 578 | TD+19M | 11 | 1. EXECUTE COMMAND SEQUENCE 2450. |
| 579 | TD+45M | SP | 1. REPORT TO A COMPLETION OF POSTLANDING ATTITUDE COMPUTATION. |
| 580 | TD+45M | FP | 1. REPORT TO A START OF POST-TOUCHDOWN ORBIT DETERMINATION (94X). |
| 581 | TD+1H19M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2450, AND STATUS OF S/C RESPONSE. |
| 582 | TD+1H20M | SS | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2452 (FIRST WIDE-ANGLE TV MAPPING). |
| 583 | TD+1H20M30S | A | 1. DIRECT SS TO CONTROL EXECUTION OF COMMAND SEQUENCE 2452. |
| | | SS | 1. CONTROL BY VOICE DIRECTION DSIF 11 |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 583 | (CONTINUED) | | EXECUTION OF COMMAND SEQUENCE 2452. |
| 584 | TD+1H21M | 11 | 1. EXECUTE COMMAND SEQUENCE 2452. |
| 585 | TD+1H27M | SS | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2452, AND STATUS OF S/C RESPONSE. |
| 586 | TD+1H35M | SS | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2453. (FIRST NARROW-ANGLE TV MAPPING). |
| 587 | TD+1H35M30S | A | 1. DIRECT SS TO CONTROL EXECUTION OF COMMAND SEQUENCE 2453. |
| | | SS | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2453. |
| 588 | TD+1H36M | 11 | 1. EXECUTE COMMAND SEQUENCE 2453. |
| 589 | TD+2H01M | SS | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2453, AND STATUS OF S/C RESPONSE. |
| 590 | TD+2H02M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2451 (ENGINEERING INTERROGATION). |
| 591 | TD+2H02M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2451. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2451. |
| 592 | TD+2H03M | 11 | 1. EXECUTE COMMAND SEQUENCE 2451. |
| 593 | TD+2H09M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2451, AND STATUS OF S/C RESPONSE. |
| 594 | TD+2H25M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2451 (ENGINEERING INTERROGATION). |
| 595 | TD+2H25M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 595 | (CONTINUED) | | COMMAND SEQUENCE 2451. |
| 596 | TD+2H25M30S | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2451. |
| 597 | TD+2H26M | 11 | 1. EXECUTE COMMAND SEQUENCE 2451. |
| 598 | TD+2H32M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2451, AND STATUS OF S/C RESPONSE. |
| 599 | TD+2H33M | SS | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2454 (SECOND WIDE-ANGLE TV MAPPING). |
| 600 | TD+2H33M30S | A | 1. DIRECT SS TO CONTROL EXECUTION OF COMMAND SEQUENCE 2454. |
| | | SS | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2454. |
| 601 | TD+2H34M | 11 | 1. EXECUTE COMMAND SEQUENCE 2454. |
| 602 | TD+2H55M | SS | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2454, AND STATUS OF S/C RESPONSE. |
| 603 | TD+2H56M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2451 (ENGINEERING INTERROGATION). |
| 604 | TD+2H56M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2451. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2451. |
| 605 | TD+2H57M | 11 | 1. EXECUTE COMMAND SEQUENCE 2451. |
| 606 | TD+3H03M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2451, AND STATUS OF S/C RESPONSE. |
| 607 | TD+3H25M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2451 (ENGINEERING |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 607 | (CONTINUED) | | INTERROGATION). |
| 608 | TD+3H25M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2451. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2451. |
| 609 | TD+3H26M | 11 | 1. EXECUTE COMMAND SEQUENCE 2451. |
| 610 | TD+3H32M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2451, AND STATUS OF S/C RESPONSE. |
| 611 | TD+3H33M | SS | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2455 (SECOND NARROW-ANGLE TV MAPPING SURVEY). |
| 612 | TD+3H33M30S | A | 1. DIRECT SS TO CONTROL EXECUTION OF COMMAND SEQUENCE 2455. |
| | | SS | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2455. |
| 613 | TD+3H34M | 11 | 1. EXECUTE COMMAND SEQUENCE 2455. |
| 614 | TD+3H45M | FP | 1. REPORT TO A COMPLETION OF POST-TOUCHDOWN ORBIT DETERMINATION. |
| | | | 2. GIVE LANDING SITE DATA TO SP, SS. |
| | | | 3. BEGIN TRAJECTORY COMPUTATION (94X). |
| 615 | TD+3H55M | FP | 1. COMPLETE TRAJECTORY COMPUTATION. |
| 616 | TD+4H04M | SS | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2455, AND STATUS OF S/C RESPONSE. |
| 617 | TD+4H05M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2451 (ENGINEERING INTERROGATION). |
| 618 | TD+4H05M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2451. |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 618 | (CONTINUED) | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2451. |
| 619 | TD+4H06M | 11 | 1. EXECUTE COMMAND SEQUENCE 2451. |
| 620 | TD+4H12M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2451, AND STATUS OF S/C RESPONSE. |
| 621 | TD+4H13M | SS | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2456 (THIRD NARROW-ANGLE TV MAPPING). |
| 622 | TD+4H13M30S | A | 1. DIRECT SS TO CONTROL EXECUTION OF COMMAND SEQUENCE 2456. |
| | | SS | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2456. |
| 623 | TD+4H14M | 11 | 1. EXECUTE COMMAND SEQUENCE 2456. |
| 624 | TD+4H24M | SS | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2456, AND STATUS OF S/C RESPONSE. |
| 625 | TD+4H25M | SP | 1. REPORT TO A DECISION TO EXECUTE COMMAND SEQUENCE 2451 (ENGINEERING INTERROGATION). |
| 626 | TD+4H25M30S | A | 1. DIRECT SP TO CONTROL EXECUTION OF COMMAND SEQUENCE 2451. |
| | | SP | 1. CONTROL BY VOICE DIRECTION DSIF 11 EXECUTION OF COMMAND SEQUENCE 2451. |
| 627 | TD+4H26M | 11 | 1. EXECUTE COMMAND SEQUENCE 2451. |
| 628 | TD+4H32M | SP | 1. REPORT TO A COMPLETION OF EXECUTION OF COMMAND SEQUENCE 2451, AND STATUS OF S/C RESPONSE. |
| 629 | TD+5H | 11 | 1. VISIBILITY ENDS. |
| | | --NOTES-- | 1. TV SURVEYS TO AVERAGE 12 HOURS PER 24-HOUR DAY UNTIL THE DAY/NIGHT TER- |

| ITEM | TIME OF EVENT | STATION | EVENT |
|---|---|---|---|
| 629 | (CONTINUED) | | MINATOR. MORE EXACT USAGE PERIODS WILL BE SPECIFIED LATER. |
| | | | 2. ENGINEERING INTERROGATIONS TO BE PERFORMED EITHER CONTINUOUSLY OR AT HALF-HOUR INTERVALS UNTIL THE DAY/ NIGHT TERMINATOR. MORE EXACT USAGE PERIODS WILL BE SPECIFIED LATER. |
| 630 | TD+10H | 51 | 1. REPOSITION PLANAR ARRAY AND SOLAR PANEL. |
| 631 | TD+21H | 11 | 1. REPOSITION PLANAR ARRAY AND SOLAR PANEL. |
| 632 | TD+34H | 51 | 1. REPOSITION PLANAR ARRAY AND SOLAR PANEL. |
| 633 | TD+46H | 11 | 1. REPOSITION PLANAR ARRAY AND SOLAR PANEL. |
| 634 | TD+57H | 51 | 1. REPOSITION PLANAR ARRAY AND SOLAR PANEL. |
| 635 | TD+61H | S/C | 1. TV CAMERA LOW-TEMPERATURE LIMIT IS REACHED. |
| 636 | TD+67H | 51 | 1. REPOSITION PLANAR ARRAY AND SOLAR PANEL. |
| 637 | TD+71H | | 1. DAY/NIGHT TERMINATOR. |
| 638 | TD+111H | S/C | 1. MEAN BATTERY DEPLETION TIME. |

## GLOSSARY OF COMMAND SEQUENCES REQUIRED DURING STANDARD SEQUENCE OF EVENTS

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| 2050 | | | Pre-Sun S/C Preparation and Bit Rate Selection |
| | 0040 | | Coast to Commutator 1/Accel. Off |
| | | 0623 | Basic Bus Acc. Amp. Off |
| | | 0512 | Aux. Acc. Amp. Off |
| | | 0510 | Aux. Commutators Off |
| | | 0226 | Engrg. Commutator No. 1 On |
| | 0041 | | Initial 4400 bps Selection |
| | | 0237 | Low Modulation Index SCO Off |
| | | 0217 | 33 kc A/D SCO On |
| | | 0206 | A/D Clock Rate 4400 bps |
| | | 0000 | Quantitative Command |
| 2051 | | | Sun Acquisition |
| | 0042 | | Sun Acquisition Mode |
| | | 0702 | Sun Acquisition Mode On |
| | 0043 | | Postmaneuver Commutator 4 Selection |
| | | 0704 | Cruise Mode On |
| | | 0231 | Engrg. Commutator No. 4 On |
| | 0044 | | Commutator 2 Selection |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0045 | | Commutator 3 Selection |
| | | 0230 | Engrg. Commutator No. 3 On |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| 2052 | | | Coast Phase Preparation (1100 bps) |
| | 0046 | | 4400 to 1100 bps Change |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0216 | 7.35 kc, A/D SCO On |
| | | 0205 | A/D Clock Rate 1100 bps |
| | 0047 | | Low Pwr./Coast Commutator |
| | | 0232 | Engrg. Commutators Off |
| | | 0506 | Coast Phase Commutator On |
| | | 0107 | Transmitter High Voltage Off |
| | | 0130 | Transfer Sw. B Low Power |
| | | 0110 | Transmitter Filament Power Off |
| 2055 | | | Coast Phase Bit Rate Reduction Sequence/550 from 4400, 1100 |
| | 0140 | | High Rate to 550 bps Change |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc A/D SCOs Off |
| | | 0215 | 3.9 kc A/D SCO On |
| | | 0204 | A/D Coast Phase Clock Rates |
| | | 0503 | A/D Clock Rate 550 bps |
| 2056 | | | High Pwr. Engineering Interrogation (4400 bps, from 550 bps) |
| | 0141 | | Xmitter B Filament |
| | | 0105 | Transmitter B Filament Power On |
| | 0142 | | Coast to Commutator 2 |
| | | 0510 | Aux. Commutators Off |
| | | 0227 | Engrg. Commutator No. 2 On |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0143 | | High Power/550 to 4400 bps Change |
| | | 0127 | Transfer Sw. B High Power |
| | | 0106 | Transmitter B High Voltage On |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc A/D SCOs Off |
| | | 0217 | 33 kc A/D SCO On |
| | | 0206 | A/D Clock Rate 4400 bps |
| | 0144 | | Commutator 4 Selection |
| | | 0231 | Engrg. Commutator No. 4 On |
| | 0145 | | Commutator 1 Selection |
| | | 0226 | Engrg. Commutator No. 1 On |
| 2150 | | | Star Verification (Transponder Off, Two Rotations) |
| | 0146 | | Transponder Off/DSIF Reacquisition |
| | | 0124 | Transponder Power Off |
| | 0147 | | Star Maneuver Preparation |
| | | 0704 | Cruise Mode On |
| | | 0715 | Manual Delay Mode On |
| | | 0710 | Positive Angle Maneuver |
| | 0240 | | Roll |
| | | 0711 | Roll |
| | 0241 | | Select Omni A |
| | | 0120 | Select Omniantenna A |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0243 | | Sun and Star Mode |
| | | 0703 | Sun and Star Mode On |
| | 0244 | | Cruise Mode |
| | | 0704 | Cruise Mode On |
| | 0245 | | Transponder On/DSIF Reacquisition |
| | | 0123 | Transponder B Power On |
| 2053 | | | Coast Phase Preparation (137.5 bps) |
| | 0246 | | High Rate to 137.5 bps Change |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc, A/D SCOs Off |
| | | 0500 | Coast Phase I A/D SCO On |
| | | 0204 | A/D Coast Phase Clock Rates |
| | | 0504 | A/D Clock Rate 137.5 bps |
| | 0047 | | Low Pwr./Coast Commutator |
| | | 0232 | Engrg. Commutators Off |
| | | 0506 | Coast Phase Commutator On |
| | | 0107 | Transmitter High Voltage Off |
| | | 0130 | Transfer Sw. B Low Power |
| | | 0110 | Transmitter Filament Power Off |
| 2057 | | | High-Power Engineering Interrogation (4400 bps from 137.5, 17.2) |
| | 0141 | | Xmitter B Filament |
| | | 0105 | Transmitter B Filament Power On |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0142 | | Coast to Commutator 2 |
| | | 0510 | Aux. Commutators Off |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0247 | | High Power/Low Rate to 4400 bps |
| | | 0127 | Transfer Sw. B High Voltage On |
| | | 0106 | Transmitter B High Voltage On |
| | | 0502 | Coast Phase A/D SCOs Off |
| | | 0217 | 33 kc A/D SCO On |
| | | 0206 | A/D Clock Rate 4400 bps |
| | 0144 | | Commutator 4 Selection |
| | | 0231 | Engrg. Commutator No. 4 On |
| | 0145 | | Commutator 1 Selection |
| | | 0226 | Engrg. Commutator No. 1 On |
| 2151 | | | Early Gyro Speed Check |
| | 0340 | | Engrg. Commutator Off |
| | | 0232 | Engrg. Commutators Off |
| | 0341 | | SCO to Gyro Processing |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc A/D SCOs Off |
| | | 0221 | Gyro Speed Signal Processing On |
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |
| | 0343 | | Gyro Processing Off |
| | | 0223 | Gyro Speed Signal Processing Off |
| 2152 | | | Post-Gyro Check Coast Phase Preparation (137.5 bps) |
| | 0344 | | 137.5 bps Selection |
| | | 0500 | Coast Phase I A/D SCO On |
| | | 0204 | A/D Coast Phase Clock Rates |
| | | 0504 | A/D Clock Rate 137.5 bps |
| | 0345 | | Low Pwr./Coast Commutator |
| | | 0506 | Coast Phase Commutator On |
| | | 0107 | Transmitter High Voltage Off |
| | | 0130 | Transfer Sw. B Low Power |
| | | 0110 | Transmitter Filament Power Off |
| 2154 | | | Late Gyro Speed Check/4400 bps Return |
| | 0341 | | SCO to Gyro Processing |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc A/D SCOs Off |
| | | 0221 | Gyro Speed Signal Processing On |
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |
| | 0346 | | Gyro Processing to 33 kc SCO |
| | | 0223 | Gyro Speed Signal Processing Off |
| | | 0217 | 33 kc A/D SCO On |
| 2155 | | | Midcourse Correction Preparation Sequence |
| | 0347 | | Premidcourse Thrust Preparation |
| | | 3617 | Interlock Command |
| | | 0607 | Pressurize Vernier System (Helium) |
| | 0440 | | Premidcourse Roll Parameters |
| | | 0704 | Cruise Mode On |
| | | ---- | Quantitative |
| | | 0710 (if required) | Positive Angle Maneuver |
| | 0441 | | Sun and Roll |
| | | 0714 | Sun and Roll |
| | 0442 | | Premidcourse Yaw (Pitch) Parameters |
| | | 0702 (if required) | Sun Acquisition Mode On |
| | | ---- | Quantitative |
| | | 0710 (if required) | Positive Angle Maneuver |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0443 | | Yaw (0444 - Pitch) |
| | | 0713 | Yaw (0712 - Pitch) |
| | 0445 | | Reset Set IV Latch |
| | | 0720 | Reset Set IV Outputs |
| | 0446 | | Thrust Phase Power |
| | | 0727 | Flight Control Thrust Phase Power On |
| | 0447 | | Strain Gauge/Midcourse Thrust Parameters |
| | | 0521 | Propulsion Strain Gauge Power On |
| | | 0700 | Inertial Mode On |
| | | ---- | Quantitative |
| 2156 | | | Midcourse Thrust Execution |
| | | 3617 | Interlock |
| | | 0721 | Midcourse Velocity Correction |
| 2157 | | | Postmidcourse Spacecraft Return to Coast |
| | 0540 | | |
| | | 0737 | Flight Control Thrust Phase Power Off |
| | | 0522 | Propulsion Strain Gauge Power Off |
| | 0541 | | Postmidcourse Yaw (Pitch) Parameters |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | | 0700 | Inertial Mode On |
| | | ---- | Quantitative |
| | | 0710 (if required) | Positive Angle Maneuver |
| | 0443 | | Yaw (0444 - Pitch) |
| | | 0713 | Yaw (0712 - Pitch) |
| | 0542 | | Postmidcourse Roll Parameters and Vernier Purge Termination |
| | | 0702 | Sun Acquisition Mode On |
| | | 0736 | Terminate Vernier Engine Vent |
| | | ---- | Quantitative |
| | | 0710 | Positive Angle Maneuver |
| | 0441 | | Sun and Roll |
| | | 0714 | Sun and Roll |
| | 0243 | | Sun and Star Mode |
| | | 0703 | Sun and Star Mode On |
| | 0543 | | Postmaneuver Commutator 2 Selection |
| | | 0704 | Cruise Mode On |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0144 | | Commutator 4 Selection |
| | | 0231 | Engrg. Commutator No. 4 On |
| 2054 | | | Coast Phase Preparation (17.2 bps) |
| | 0544 | | 4400/1100 to 17.2 bps Change |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0501 | Coast Phase II A/D SCO On |
| | | 0204 | A/D Coast Phase Clock Rates |
| | | 0505 | A/D Clock Rate 17.2 bps |
| | 0047 | | Low Pwr./Coast Commutator |
| | | 0232 | Engrg. Commutators Off |
| | | 0506 | Coast Phase Commutator On |
| | | 0107 | Transmitter High Voltage Off |
| | | 0130 | Transfer Sw. B Low Power |
| | | 0110 | Transmitter Fil. Power Off |
| 2250 | | | High Power Before Star Verification |
| | 0141 | | Xmitter B Filament |
| | | 0105 | Transmitter B Filament Power On |
| | 0545 | | Coast to Commutator 1 |
| | | 0510 | Aux. Commutators Off |
| | | 0226 | Engrg. Commutator No. 1 On |
| | 0247 | | High Power/Low Rate to 4400 bps Change |
| | | 0127 | Transfer Sw. B High Power |
| | | 0106 | Transmitter B High Voltage On |
| | | 0502 | Coast Phase A/D SCOs Off |
| | | 0217 | 33 kc A/D SCO On |
| | | 0206 | A/D Clock Rate 4400 bps |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| 2251 | | | Low-Power Engineering Interrogation |
| | 0142 | | Coast to Commutator 2 |
| | | 0510 | Aux. Commutators Off |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0144 | | Commutator 4 Selection |
| | | 0231 | Engrg. Commutator No. 4 On |
| | 0145 | | Commutator 1 Selection |
| | | 0226 | Engrg. Commutator No. 1 On |
| | 0546 | | Engrg. to Coast Commutator |
| | | 0232 | Engrg. Commutators Off |
| | | 0506 | Coast Phase Commutator On |
| 2252 | | | Vernier Thermal Control |
| | | 0612 | Vernier Fuel Tank No. 2 Thermal Control Power On |
| | | 0615 | Vernier Oxidizer Tank No. 2 Thermal Control Power On |
| | | 0620 | Vernier Oxidizer Tank No. 3 Thermal Control Power On |
| 2253 | | | Survey Camera Warmup |
| | | 1133 | Vidicon Temp. Control On Survey Camera |
| | | 1136 | Electronics Temp. Control On Survey Camera |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| 2254 | | | Approach Camera Warmup |
| | | 0131 | Vidicon Temp. Control On Approach Camera |
| | | 0136 | Electronics Temp. Control On Approach Camera |
| 2255 | | | High-Power Engineering Interrogation (AMR Warmup - 1100 bps from 137.5, 17.2) |
| | 0141 | | Xmitter B Filament |
| | | 0105 | Transmitter B Filament Power On |
| | 0142 | | Coast to Commutator 2 |
| | | 0510 | Aux. Commutators Off |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0547 | | High Pwr./Low Rate to 1100 bps Change |
| | | 0127 | Transfer Sw. B High Power |
| | | 0106 | Transmitter B High Voltage On |
| | | 0502 | Coast Phase A/D SCOs Off |
| | | 0216 | 7.35 kc A/D SCO On |
| | | 0205 | A/D Clock Rate 1100 bps |
| | 0144 | | Commutator 4 Selection |
| | | 0231 | Engrg. Commutator No. 4 On |
| | 0640 | | AMR Warmup |
| | | 0624 | AMR Heater On |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0145 | | Commutator 1 Selection |
| | | 0226 | Engrg. Commutator No. 1 On |
| 2256 | | | High-Power Engineering Interrogation (1100 bps from 137.5, 17.2) |
| | 0141 | | Xmitter B Filament |
| | | 0105 | Transmitter B Filament Power On |
| | 0142 | | Coast to Commutator 2 |
| | | 0510 | Aux. Commutators Off |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0547 | | High Power/Low Rate to 1100 bps Change |
| | | 0127 | Transfer Sw. B High Power |
| | | 0106 | Transmitter B High Voltage On |
| | | 0502 | Coast Phase A/D SCOs Off |
| | | 0216 | 7.35 kc A/D SCO On |
| | | 0205 | A/D Clock Rate 1100 bps |
| | 0144 | | Commutator 4 Selection |
| | | 0231 | Engrg. Commutator No. 4 On |
| | 0145 | | Commutator 1 Selection |
| | | 0226 | Engrg. Commutator No. 1 On |
| 2257 | | | VCXO and VCO Frequency Check |
| | 0146 | | Xponder Off/DSIF Reacquisition |
| | | 0124 | Transponder Power Off |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0641 | | Narrow-Band VCXO Off |
| | | 0113 | Narrow-Band VCXO Off |
| | 0642 | | Narrow-Band VCXO, Xponder on/ DSIF Reacquisition |
| | | 0112 | Narrow-Band VCXO On |
| | | 0123 | Transponder B Power On |
| 2153 | | | Post-Gyro Check Coast Phase Preparation (17.2 bps) |
| | 0643 | | 17.2 bps Selection |
| | | 0501 | Coast Phase II A/D SCO On |
| | | 0204 | A/D Coast Phase Clock Rates |
| | | 0505 | A/D Clock Rate 17.2 bps |
| | 0345 | | Low Pwr./Coast Commutator |
| | | 0506 | Coast Phase Commutator On |
| | | 0107 | Transmitter High Voltage Off |
| | | 0130 | Transfer Sw. B Low Power |
| | | 0110 | Transmitter Filament Power Off |
| 2350 | | | Late Gyro Speed Check/1100 bps Return |
| | 0341 | | SCO to Gyro Processing |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc A/D SCOs Off |
| | | 0221 | Gyro Speed Signal Processing On |
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |
| | 0342 | | Next Gyro |
| | | 0222 | Select Next Gyro Speed Channel |
| | 0644 | | Gyro Processing to 7. 35 kc SCO |
| | | 0223 | Gyro Speed Signal Processing Off |
| | | 0216 | 7. 35 kc A/D SCO On |
| 2351 | | | Planar Array Deployment |
| | 0044 | | Commutator 2 Selection |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0645 | | Step Polar Axis Plus |
| | | 0403 | (n Times) |
| | 0145 | | Commutator 1 Selection |
| | | 0226 | Engrg. Commutator No. 1 On |
| 2352 | | | Terminal Maneuver Preparation |
| | 0646 | | Terminal First Roll Parameters |
| | | 0704 | Cruise Mode On |
| | | ---- | Quantitative |
| | | 0710 (if required) | Positive Angle Maneuver |
| | 0441 | | Sun and Roll |
| | | 0714 | Sun and Roll |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0647 | | Terminal Yaw (Pitch) Parameters |
| | | 0702 (if required) | Sun Acquisition Mode On |
| | | ---- | Quantitative |
| | | 0710 (if required) | Positive Angle Maneuver |
| | 0443 | | Yaw (0444 - Pitch) |
| | | 0713 | Yaw (0712 - Pitch) |
| | 0740 | | Terminal Second Roll Parameters |
| | | 0700 | Inertial Mode On |
| | | ---- | Quantitative |
| | | 0710 (if required) | Positive Angle Maneuver |
| | 0240 | | Roll |
| | | 0711 | Roll |
| | 0741 | | Inertial Mode |
| | | 0700 | Inertial Mode On |
| 2353 | | | Preapproach Telecommunications Preparation |
| | 0742 | | Xmitter B to Planar Array |
| | | 0116 | Transmitter B to Planar Array |
| | 0743 | | Xponder/VCXO/Summing Amps Off |
| | | 0124 | Transponder Power Off |
| | | 0113 | Narrow-Band VCXO Off |
| | | 0214 | Summing Amplifiers Off |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 0744 | | Frequency-Summing Amp. B |
| | | 0213 | Frequency-Summing Amplifier B On |
| | 0745 | | 1100 to 4400 bps/Commutator 2 Selection |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0217 | 33 kc A/D SCO On |
| | | 0206 | A/D Clock Rate 4400 bps |
| | | 0227 | Engrg. Commutator No. 2 On |
| | 0746 | | Approach Camera Temp. Control Off |
| | | 0135 | Temperature Control Off Approach Camera |
| | 0747 | | |
| | | 0132 | Power On Approach Camera |
| | | 0722 | Select Nominal Thrust Bias (if required) |
| 2354 | | | First Approach TV Sequence/Retro Sequence Preparation |
| | 1040 | | Forty-Picture TV |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0133 | (40 Times, 4 Sec. Apart) Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | 1041 | | Retro Parameters |
| | | 0700 | Inertial Mode On |
| | | ---- | Quantitative |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 1042 | | Retro Sequence Mode On |
| | | 3617 | Interlock Command |
| | | 0724 | Retro Sequence Mode On |
| 2355 | | | Final Approach Sequence |
| | 1043 | | Ten-Picture TV/Survey Camera Temp. Control Off |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0133 | (10 Times, 4 Sec. Apart) Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | | 1137 | Temperature Control Off Survey Camera |
| | | 1134 | Vidicon Temperature Control Off Survey Camera |
| | 1044 | | AMR Pwr./Reset Set IV Latch |
| | | 0613 | Vernier Lines No. 2 and Vernier Fuel Tank No. 2 Thermal Control Pwr. Off |
| | | 0616 | Vernier Lines No. 1 and Vernier Oxidizer Tank No. 2 Thermal Control Pwr. Off |
| | | 0621 | Vernier Lines No. 3 and Vernier Oxidizer Tank No. 3 Thermal Control Pwr. Off |
| | | 0625 | Altitude Marking Radar Pwr. On |
| | | 0720 | Reset Set IV Output |
| | 0446 | | Thrust Phase Power |
| | | 0727 | Thrust Phase Power On |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | 1045 | | Accelerometer/Strain Gauge Pwr. |
| | | 0622 | Basic Bus Accelerometer Amp. On |
| | | 0521 | Propulsion Strain Gauge Power On |
| | | 0511 | Aux. Accelerometer Amp. On |
| | 1046 | | Thirty-Picture TV |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0133 | (30 Times, 4 Sec. Apart) Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | 1047 | | Disable Battery Transfer Logic |
| | | 0321 | Disable Battery Transfer Logic |
| | 1140 | | High Current |
| | | 0322 | High-Current Mode On Approach TV Sequence No. 4 |
| | 1141 | | Ten-Picture TV Sequence |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0133 | (10 Times, 4 Sec. Apart) Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | 1142 | | AMR Enable/Three TV Pictures/ Accel. Channels |
| | | 0626 | Enable Altitude Marking Radar |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | | 0133 | (3 Times, 4 Sec. Apart) Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | | 0224 | Basic Bus Accel. Channels On |
| | | 0513 | Aux. Accel. Channels On |
| | | 0604 | AMR Heater Off |
| | 1143 | | Two-Picture TV Sequence |
| | | 0225 | Basic Bus Accel. Channels Off |
| | | 0514 | Aux. Accel. Data Channels Off |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0133 | (2 Times, 4 Sec. Apart) Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | | 0224 | Basic Bus Accel. Channels On |
| | | 0513 | Aux. Accel. Channels On |
| | 1144 | | Last TV |
| | | 0225 | Basic Bus Accel. Channels Off |
| | | 0514 | Aux. Accel. Data Channels Off |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0133 | Start Frame Approach Camera |
| | | 0217 | 33 kc A/D SCO On |
| | 1145 | | Telecommunications Transfer |
| | | 0117 | Transmitter A to Planar Array |
| | | 0112 | Narrow-Band VCXO On |
| | | 0220 | 33 kc, 7.35 kc, 3.9 kc SCOs Off |
| | | 0214 | Summing Amplifiers Off |

(This table continued on next page.)

GLOSSARY (CONT'D)

| MAJOR SEQUENCE | MINOR SEQUENCE | COMMANDS | DESCRIPTION |
|---|---|---|---|
| | | 0207 | Presumming Amplifier On |
| | | 0211 | Phase-Summing Amplifier B On |
| | | 0216 | 7.35 kc A/D SCO On |
| | | 0205 | A/D Clock Rate 1100 bps |
| | | 0230 | Engrg. Commutator No. 3 On |
| | | 0515 | Touchdown Strain Gauge Pwr. On |
| | | 0517 | Touchdown Strain Gauge Data Channels On |
| 2356 | | | Postlanding Operations |
| | | 0226 | Engrg. Commutator No. 1 On |
| | | 3617 | Interlock |
| | | 0630 | RADVS Power Off (Interlocked) |
| | | 3617 | Interlock |
| | | 0311 | All Flight Control Pwr. Off (Interlocked) |
| | | 0134 | Power Off Approach Camera |
| | | 0516 | Touchdown Strain Gauge Power Off |
| | | 0522 | Propulsion Strain Gauge Power Off |
| | | 0636 | Lock Landing Gear |
| | | 3617 | Interlock |
| | | 0610 | Dump Helium (Interlocked) |
| | | 0323 | High-Current Mode Off |

# SECTION VI

# NONSTANDARD OPERATIONS

## A. GENERAL

Section V presents, on a certain prescribed level, the normal, or standard, sequence of events. It is recognized that deviations from this standard will occur; therefore, every effort must be made to define various failure modes in anticipation of such events. Several representative situations are included in this Section with a discussion of the methods by which these situations would be handled operationally.

## B. NONSTANDARD PROCEDURE DEVELOPMENT

The nonstandard situations which may arise during the course of a mission can be classified as:

Prepared

Corrective action will be available.

Nonprepared

Corrective action will be determined at the time these situations are encountered.

A further breakdown of the categories may be given in which the degree of criticalness of time is considered.

Class A - Nonstandard, prepared, noncritical

Class B - Nonstandard, prepared, critical

Class C - Nonstandard, nonprepared, noncritical

Class D - Nonstandard, nonprepared, critical

The number of combinations of failures which may occur within the above classification is practically limitless. As a result, development of nonstandard sequences is restricted to those cases where only single failures exist and telemetry is assumed to be operating normally. Exhaustive analysis of such anticipated situations, taking into consideration the probability of occurrence, etc., has resulted in a limited set of situations which have been studied further. Fault isolation trees, listed in Table VI-I, have been devised for these situations. The trees are identified by the numbers 1 through 31 and are referred to as Nonstandard Procedures (NSPs).

TABLE VI-I. FAULT ISOLATION TREES

| IDENTIFICATION NUMBER | DESCRIPTION TITLE |
|---|---|
| 1 | Landing gear mechanism; omnidirectional antenna mechanism/electrical |
| 3 | Centaur separation |
| 4 | Flight control coast phase |
| 5 | Coast phase roll control |
| 6 | Flight control programmer |
| 7 | One-way DSIF spacecraft acquisition |
| 8 | Two-way DSIF spacecraft acquisition/T/M lockup |
| 9 | Solar panel positioning |
| 10 | Conservation of battery energy |
| 11 | Solar panel not in transit position |
| 12 | Sun acquisition |
| 13 | Solar panel electrical |
| 14 | Star acquisition |
| 15 | Planar array as roll attitude reference |
| 16 | Prethrust attitude maneuver |
| 17 | Flight control thrust phase |
| 18 | Loss of capability to soft-land |
| 19 | Loss of capability to hit Moon |
| 20 | Standard attitude maneuver |
| 21 | Engineering interrogation |
| 22 | Power management |
| 23 | Thermal management |
| 24 | Preretro attitude maneuver and descent TV |
| 25 | Terminal descent |
| 27 | Large injection errors |
| 29 | Loss of signal from the spacecraft |
| 30 | Regulated power supply |
| 31 | Battery |

## C. USE OF FAULT ISOLATION TREES

The Nonstandard Procedures are to serve as the mechanism of operations control during the analysis of spacecraft failures, within the limitations imposed by the assumption of single faults. SPAC has the primary responsibility for the required interpretation of spacecraft data and determination of command decisions. If the single fault limitation does not hold, SPAC may intermesh certain applicable trees, and use any additional techniques necessary to isolate the faults in order to arrive at a satisfactory recommended course of action. The DSIF will use preprepared command tapes according to Detailed Operating Procedures (DOPs), where necessary, in support of SPAC, as directed by Mission Control.

When deviations from the standard sequence occur, and anticipated nonstandard procedures exist, the SFOD will direct SPAC to proceed in accordance with the applicable fault isolation tree. A representative tree is shown in Figure VI-1. It should be noted that command sequences are identified by the sequence number associated with the commands on the nonstandard command tape. Corresponding DOP item numbers are given to allow fast cross-reference between the tree and the DOP, primarily for use by DSIF personnel.

Branch choice within a tree is determined by the conditions existing as a result of the fault and as indicated by the current spacecraft telemetry. All trees are developed so that return to the Standard Sequence of Events may be accomplished within a minimum time.

## D. GENERAL NONSTANDARD OPERATIONS PROCEDURES

The execution of commands required in nonstandard spacecraft situations will generally be implemented through one of the Command System Alternatives described in Section IV.

For nonstandard Classes A and B, above, the required spacecraft commands will be grouped on preprepared CDC command tapes at the DSIF. Execution of commands in these situations will be according to Alternative No. 1.

For nonstandard Class C, the required commands can be formulated at the SFOF manually, or by means of the SCP/CVT program, and transmitted to the DSIF via TTY (Command System Alternative No. 2).

Execution of commands in nonstandard Class D (Nonprepared, Time Critical) will be negotiated in the framework of Alternative No. 3. Commands will be entered on the CDC keyboard, as directed, by voice from the SFOF.

IDENTIFICATION SEQUENCE - 20F8

NSP-8 - S/C-DSIF TWO-WAY ACQUISITION/TM LOCKUP
NON-STANDARD PROCEDURES

ASSUMPTIONS

1. ONE-WAY ACQUISITION HAS BEEN ACCOMPLISHED
2. UNLESS OTHERWISE NOTED, OPERATING WITH TRANSMITTER B/RECEIVER B/OMNI-B COMBINATION
3. COAST PHASE COMMUTATOR IN USE
4. S/C TRANSMITTER UNDER VCXO CONTROL
5. CDC/DSIF EQUIPMENT FUNCTIONING PROPERLY

REQUIRED INSTRUMENTATION:

1. RECEIVER A AND B AGC (D-9, D-18) MODE 4, C
2. RECEIVER A AND B APC (D-16, D-17) MODE 4, C
3. STATIC PHASE ERROR A AND B (D-7, D-8) MODE 4, C
4. TRANSPONDER A AND B PHASE LOCKED (D-5, D-6) MODE 1, 4, C, T

NOTE: WHENEVER BLIND COMMANDS ARE SENT, i.e., PRIOR TO ACQUISITION, EACH COMMAND PRECEDED BY A MODULATION INTERRUPTION SHOULD BE SENT TWICE, EXCEPT WHERE OTHERWISE NOTED. ADDITIONALLY, THE DSS TRANSMITTER FREQUENCY IS VARIED 1.1 KCS ABOUT THE S/C RECEIVER FREQUENCY IN 5 KCS INCREMENTS FOR EACH SET OF TWO (2) COMMANDS AND MODULATION INTERRUPTIONS.

STANDARD DSIF ACQUISITION PROCEDURES:

1. DSS RECEIVER PHASE LOCK IS "ON," INDICATING ATTAINMENT OF ONE-WAY LOCK i.e., S/C TRANSMITTER TO DSS RECEIVER
2. DSS IN MANUAL OR AIDED TRACK MODE, NULLS OUT R-F ANGLE ERRORS, SWITCHES THE ANTENNA SERVO SYSTEM TO AUTOMATIC TRACKING MODE, AND SWITCHES TO THE MAIN 85-FT TRACKING ANTENNA

(1) 1A

DSS TRANSMITTER TURNED ON, AND TWO-WAY LOCK ATTEMPTED BY ADJUSTING DSS TRANSMITTER FREQUENCY TO S/C RECEIVER PASSBAND (12 KCS), UNTIL S/C TRANSPONDER ATTAINS R-F LOCK.

OBSERVE:

1. PHASE TRANSIENT IN DSS RECEIVER FOLLOWED BY A CHANGING STATIC PHASE ERROR
2. TRANSPONDER B PHASE LOCK LIGHT "ON" (D-6)

OR

3. DSS RECEIVER LOSES LOCK (DUE TO JUMP IN S/C TRANSMITTER FREQ)

(2) 2A — S/C RECEIVER R-F PHASE LOCK ACHIEVED

2B — DSS LOSES ONE-WAY R-F LOCK → RETURN TO NSP-7 AT PT. 1A

2C — S/C RECEIVER R-F LOCK NOT ACHIEVED WITHIN ONE MINUTE → OBSERVE RECEIVER A AND B APC (D-16, D-17)

(3) 3A — SWEEP DSS TRANSMITTER FREQUENCY TO VERIFY TWO-WAY LOCK

OBSERVE S/C TRANSMITTER FREQUENCY ON DSS RECEIVER STATIC PHASE ERROR METER

(4) 4A — S/C TRANSMITTER TRACKS IN FREQUENCY (VERIFIES TWO-WAY LOCK)

OBSERVE STATIC PHASE ERROR B (D-8)

TUNE DSS TRANSMITTER TO CENTER OF S/C RECEIVER'S TUNING RANGE BY SETTING S/C STATIC PHASE ERROR TO BEST LEVEL

OBSERVE DSS RECEIVER STATIC PHASE ERROR

4B — S/C TRANSMITTER DOES NOT TRACK IN FREQUENCY

S/C TRANSMITTER TRACKS IN FREQUENCY (VERIFIES TWO-WAY LOCK)

REFER TO PT 6A

3B — RECEIVER A APC PRESENT, RECEIVER B APC NOT PRESENT

IF ON TRANSMITTER B

3C — POSSIBLE CAUSES:

1. OMNI-B IN NULL
2. RECEIVER B FAILED
3. TM FAILURE
4. TRANSPONDER B FAILED
5. RECEIVER B SECOND IF AMPLIFIER

OBSERVE RECEIVER B AGC (D-18)

IF ON TRANSMITTER A

3C — RECEIVER A APC PRESENT, RECEIVER B APC PRESENT

IF ON TRANSMITTER A

4C — TUNE DSS TRANSMITTER TO NULL RECEIVER A APC

OBSERVE RECEIVER A APC (D-16)

IF ON TRANSMITTER B

4C — TUNE DSS TRANSMITTER TO NULL RECEIVER B APC

OBSERVE RECEIVER B APC (D-17)

3D — RECEIVER A APC NOT PRESENT, RECEIVER B APC PRESENT

IF ON TRANSMITTER B

IF ON TRANSMITTER A

4C — POSSIBLE CAUSES:

1. OMNI-A IN NULL
2. RECEIVER A FAILED
3. TM FAILURE
4. TRANSPONDER A FAILED
5. RECEIVER A SECOND IF AMPLIFIER

(NOTE: TRANSMITTER B IS ASSUMED FAILED OTHERWISE, TRANSMITTER A WOULD NOT BE IN USE.)

OBSERVE RECEIVER A AGC (D-9)

3E — RECEIVER A AND RECEIVER B APC NOT PRESENT

IF OMNI-A HAS BEEN SELECTED

4E — POSSIBLE CAUSES:

1. RECEIVER A FAILED AND OMNI-B IN NULL
2. DSS TRANSMITTER FREQUENCY INCORRECT
3. TM FAILURE

IF OMNI-A HAS NOT BEEN SELECTED

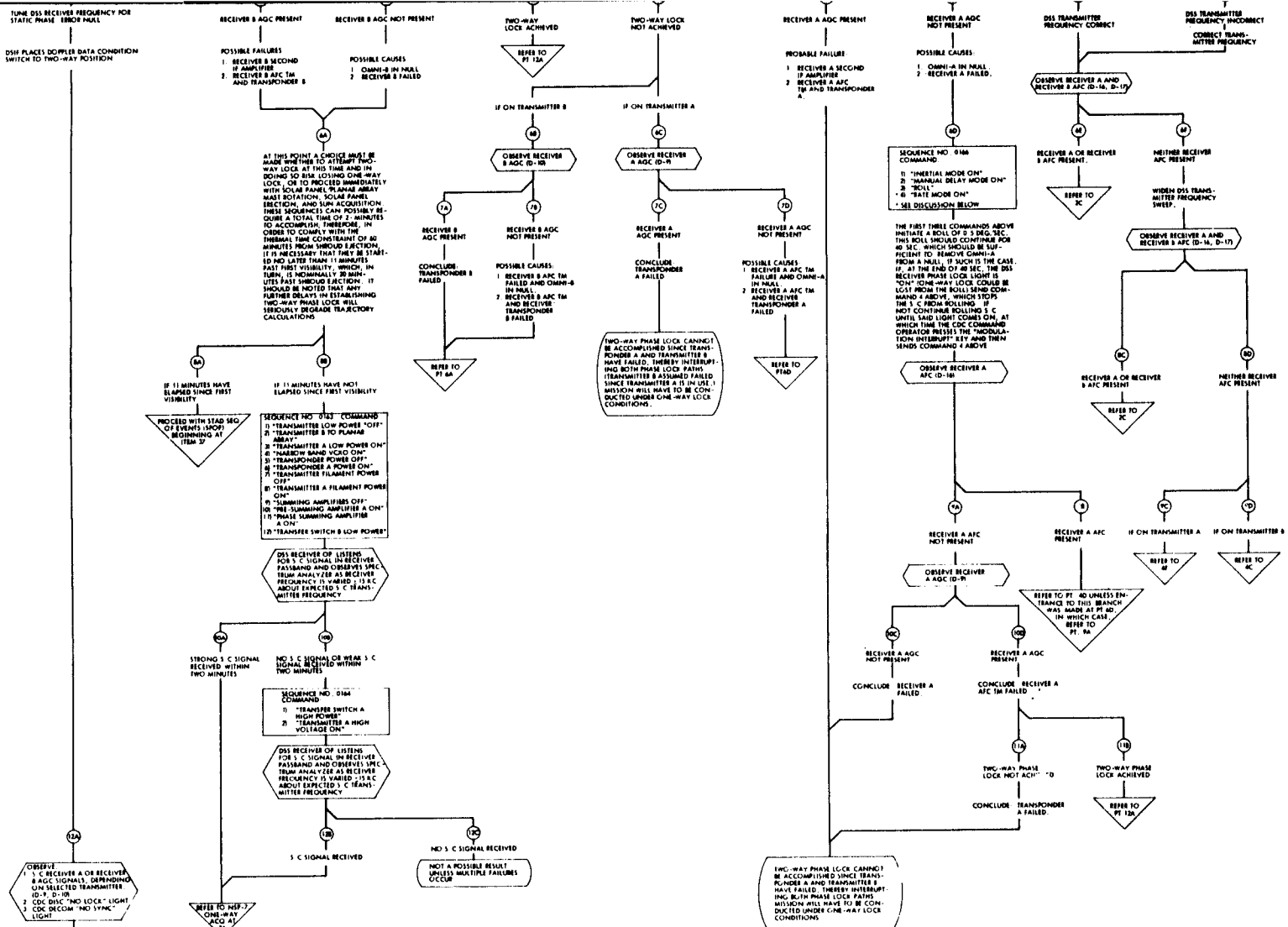
4E — POSSIBLE CAUSES:

1. RECEIVER B FAILED AND OMNI-A IN NULL
2. DSS TRANSMITTER FREQUENCY INCORRECT
3. TM FAILURE

CHECK DSS TRANSMITTER FREQUENCY

3F — NO S/C TM AVAILABLE

NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR


TUNE DSS RECEIVER FREQUENCY FOR STATIC PHASE ERROR NULL
DSIF PLACES DOPPLER DATA CONDITION SWITCH TO TWO-WAY POSITION
12A
OBSERVE
1 S C RECEIVER A OR RECEIVER B AGC SIGNALS, DEPENDING ON SELECTED TRANSMITTER (D-9, D-10)
2 CDC DISC "NO LOCK" LIGHT
3 CDC DECOM "NO SYNC" LIGHT
RECEIVER B AGC PRESENT
RECEIVER B AGC NOT PRESENT
POSSIBLE FAILURES
1. RECEIVER B SECOND IF AMPLIFIER
2. RECEIVER B AFC TM AND TRANSPONDER B
POSSIBLE CAUSES
1 OMNI-B IN NULL
2 RECEIVER B FAILED
8A
AT THIS POINT A CHOICE MUST BE MADE WHETHER TO ATTEMPT TWO-WAY LOCK AT THIS TIME AND IN DOING SO RISK LOSING ONE-WAY LOCK, OR TO PROCEED IMMEDIATELY WITH SOLAR PANEL PLANAR ARRAY MAST ROTATION, SOLAR PANEL ERECTION, AND SUN ACQUISITION. THESE SEQUENCES CAN POSSIBLY REQUIRE A TOTAL TIME OF 2 - MINUTES TO ACCOMPLISH, THEREFORE, IN ORDER TO COMPLY WITH THE THERMAL TIME CONSTRAINT OF 60 MINUTES FROM SHROUD EJECTION, IT IS NECESSARY THAT THEY BE STARTED NO LATER THAN 11 MINUTES PAST FIRST VISIBILITY, WHICH, IN TURN, IS NOMINALLY 30 MINUTES PAST SHROUD EJECTION. IT SHOULD BE NOTED THAT ANY FURTHER DELAYS IN ESTABLISHING TWO-WAY PHASE LOCK WILL SERIOUSLY DEGRADE TRAJECTORY CALCULATIONS
8A
IF 11 MINUTES HAVE ELAPSED SINCE FIRST VISIBILITY
PROCEED WITH STAD SEQ OF EVENTS (SPOF) BEGINNING AT ITEM 37
8B
IF 11 MINUTES HAVE NOT ELAPSED SINCE FIRST VISIBILITY
SEQUENCE NO. 0163 COMMAND
1) "TRANSMITTER LOW POWER "OFF"
2) "TRANSMITTER B TO PLANAR ARRAY"
3) "TRANSMITTER A LOW POWER ON"
4) "NARROW BAND VCXO ON"
5) "TRANSPONDER POWER OFF"
6) "TRANSPONDER A POWER ON"
7) "TRANSMITTER FILAMENT POWER OFF"
8) "TRANSMITTER A FILAMENT POWER ON"
9) "SUMMING AMPLIFIERS OFF"
10) "PRE-SUMMING AMPLIFIER A ON"
11) "PHASE SUMMING AMPLIFIER A ON"
12) "TRANSFER SWITCH B LOW POWER"
DSS RECEIVER OP LISTENS FOR S C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER AS RECEIVER FREQUENCY IS VARIED ±15 K C ABOUT EXPECTED S C TRANSMITTER FREQUENCY
10A
STRONG S C SIGNAL RECEIVED WITHIN TWO MINUTES
10B
NO S C SIGNAL OR WEAK S C SIGNAL RECEIVED WITHIN TWO MINUTES
SEQUENCE NO. 0164 COMMAND
1) "TRANSFER SWITCH A HIGH POWER"
2) "TRANSMITTER A HIGH VOLTAGE ON"
DSS RECEIVER OP LISTENS FOR S C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER AS RECEIVER FREQUENCY IS VARIED ±15 K C ABOUT EXPECTED S C TRANSMITTER FREQUENCY
12B
S C SIGNAL RECEIVED
REFER TO 169-7 ONE-WAY ACQ AT
12C
NO S C SIGNAL RECEIVED
NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR
TWO-WAY LOCK ACHIEVED
REFER TO PT 12A
TWO-WAY LOCK NOT ACHIEVED
IF ON TRANSMITTER B
8B
OBSERVE RECEIVER B AGC (D-10)
7A
RECEIVER B AGC PRESENT
CONCLUDE TRANSPONDER B FAILED
REFER TO PT 6A
7B
RECEIVER B AGC NOT PRESENT
POSSIBLE CAUSES:
1 RECEIVER B AFC TM FAILED AND OMNI-B IN NULL
2 RECEIVER B AFC TM AND RECEIVER TRANSPONDER B FAILED
IF ON TRANSMITTER A
8C
OBSERVE RECEIVER A AGC (D-9)
7C
RECEIVER A AGC PRESENT
CONCLUDE TRANSPONDER A FAILED
TWO-WAY PHASE LOCK CANNOT BE ACCOMPLISHED SINCE TRANSPONDER A AND TRANSMITTER B HAVE FAILED, THEREBY INTERRUPTING BOTH PHASE LOCK PATHS (TRANSMITTER B ASSUMED FAILED SINCE TRANSMITTER A IS IN USE.) MISSION WILL HAVE TO BE CONDUCTED UNDER ONE-WAY LOCK CONDITIONS.
7D
RECEIVER A AGC NOT PRESENT
POSSIBLE CAUSES
1 RECEIVER A AFC TM FAILURE AND OMNI-A IN NULL
2 RECEIVER A AFC TM AND RECEIVER TRANSPONDER A FAILED
REFER TO PT 6D
RECEIVER A AGC PRESENT
PROBABLE FAILURE
1 RECEIVER A SECOND IF AMPLIFIER
2 RECEIVER A AFC TM AND TRANSPONDER A
RECEIVER A AGC NOT PRESENT
POSSIBLE CAUSES
1 OMNI-A IN NULL
2 RECEIVER A FAILED.
6D
SEQUENCE NO. 0166 COMMAND
1) "INERTIAL MODE ON"
2) "MANUAL DELAY MODE ON"
3) "ROLL"
4) "RATE MODE ON"
* SEE DISCUSSION BELOW
THE FIRST THREE COMMANDS ABOVE INITIATE A ROLL OF 5 DEG./SEC. THIS ROLL SHOULD CONTINUE FOR 40 SEC., WHICH SHOULD BE SUFFICIENT TO REMOVE OMNI-A FROM A NULL, IF SUCH IS THE CASE. IF, AT THE END OF 40 SEC, THE DSS RECEIVER PHASE LOCK LIGHT IS "ON" (ONE-WAY LOCK COULD BE LOST FROM THE ROLL) SEND COMMAND 4 ABOVE, WHICH STOPS THE S C FROM ROLLING. IF NOT CONTINUE ROLLING S C UNTIL SAID LIGHT COMES ON, AT WHICH TIME THE CDC COMMAND OPERATOR PRESSES THE "MODULATION INTERRUPT" KEY AND THEN SENDS COMMAND 4 ABOVE
OBSERVE RECEIVER A AFC (D-16)
9A
RECEIVER A AFC NOT PRESENT
OBSERVE RECEIVER A AGC (D-9)
9C
RECEIVER A AGC NOT PRESENT
CONCLUDE RECEIVER A FAILED
10C
RECEIVER A AGC PRESENT
CONCLUDE RECEIVER A AFC TM FAILED
11A
TWO-WAY PHASE LOCK NOT ACH'D
CONCLUDE TRANSPONDER A FAILED.
11B
TWO-WAY PHASE LOCK ACHIEVED
REFER TO PT 12A
TWO-WAY PHASE LOCK CANNOT BE ACCOMPLISHED SINCE TRANSPONDER A AND TRANSMITTER B HAVE FAILED, THEREBY INTERRUPTING BOTH PHASE LOCK PATHS MISSION WILL HAVE TO BE CONDUCTED UNDER ONE-WAY LOCK CONDITIONS
9B
RECEIVER A AFC PRESENT
REFER TO PT 40 UNLESS ENTRANCE TO THIS BRANCH WAS MADE AT PT 40, IN WHICH CASE REFER TO PT 9A
DSS TRANSMITTER FREQUENCY CORRECT
DSS TRANSMITTER FREQUENCY INCORRECT
CORRECT TRANSMITTER FREQUENCY
OBSERVE RECEIVER A AND RECEIVER B AFC (D-16, D-17)
4E
RECEIVER A OR RECEIVER B AFC PRESENT.
REFER TO 3C
4F
NEITHER RECEIVER AFC PRESENT
WHEN DSS TRANSMITTER FREQUENCY SWEEP,
OBSERVE RECEIVER A AND RECEIVER B AFC (D-16, D-17)
8C
RECEIVER A OR RECEIVER B AFC PRESENT
REFER TO 2C
8D
NEITHER RECEIVER AFC PRESENT
9C
IF ON TRANSMITTER A
REFER TO 4F
9D
IF ON TRANSMITTER B
REFER TO 4C

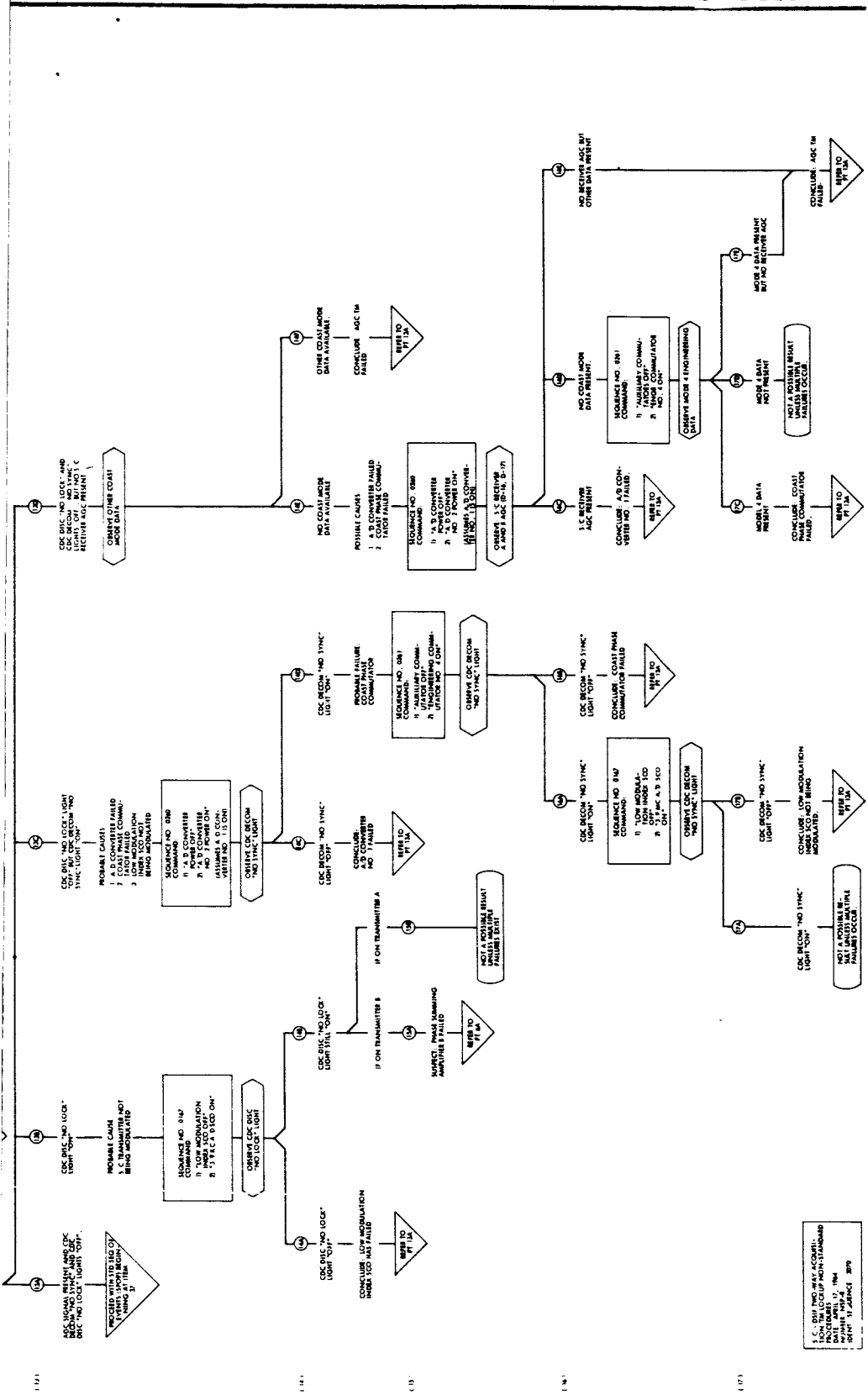


FIGURE VI-1. NSP-8-S/C-DSIF TWO-WAY ACQUISITION/TM LOCKUP NONSTANDARD PROCEDURES

IDENTIFICATION SEQUENCE 3071
NSP - 1, LANDING GEAR OMNI-ANTENNA MECHANISMS
NON-STANDARD PROCEDURES

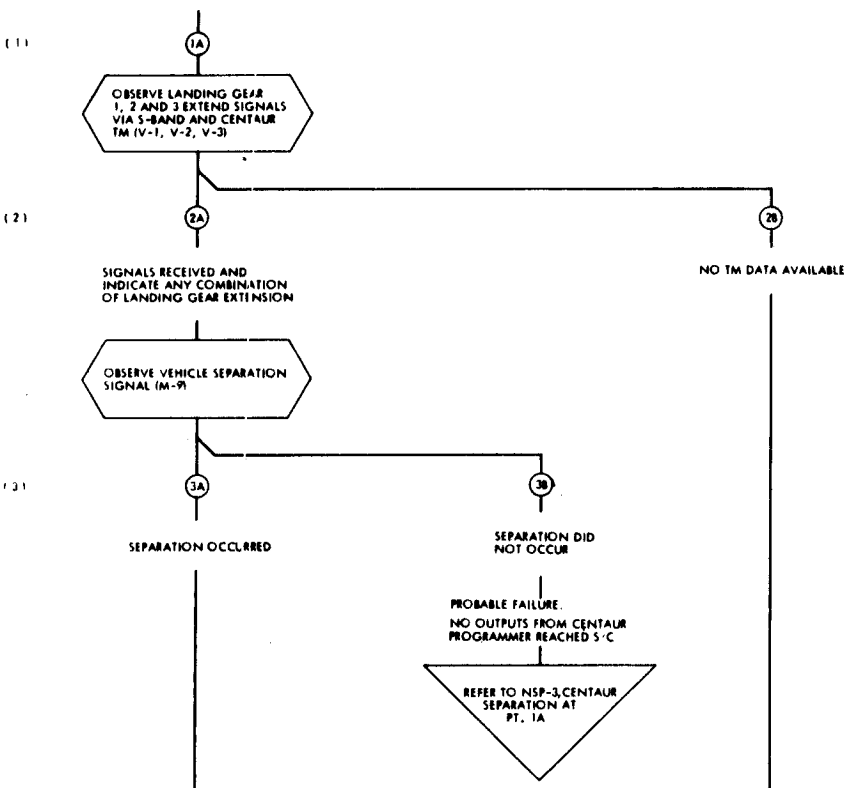
ASSUMPTIONS

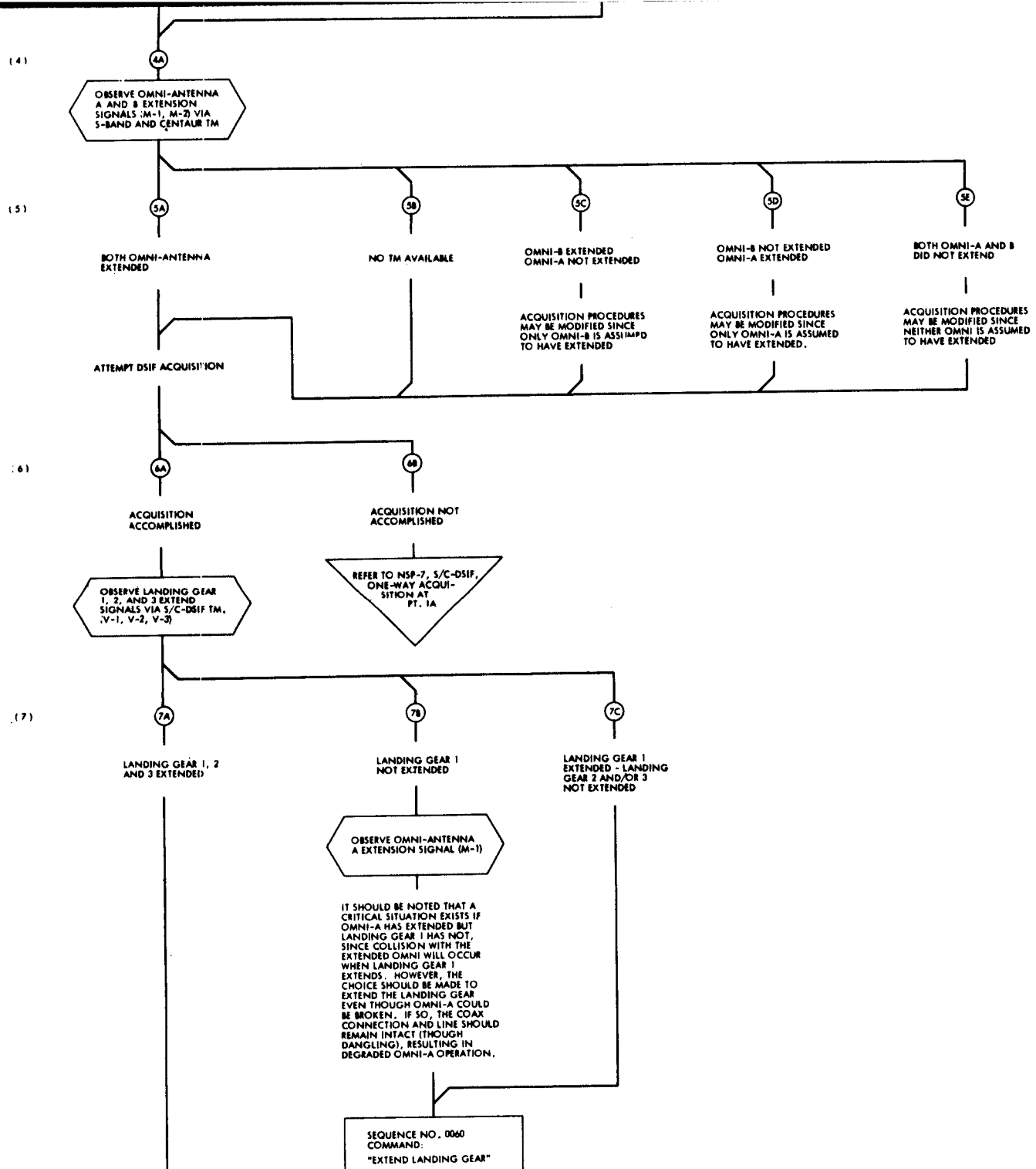
1) OMNI-B, TRANSMITTER B RECEIVER B TRANSPONDER B "ON" AT LAUNCH
2) TRACKING DATA IS AVAILABLE TO FACILITATE ACQUISITION.
3) COAST PHASE COMMUTATOR "ON" AT LAUNCH

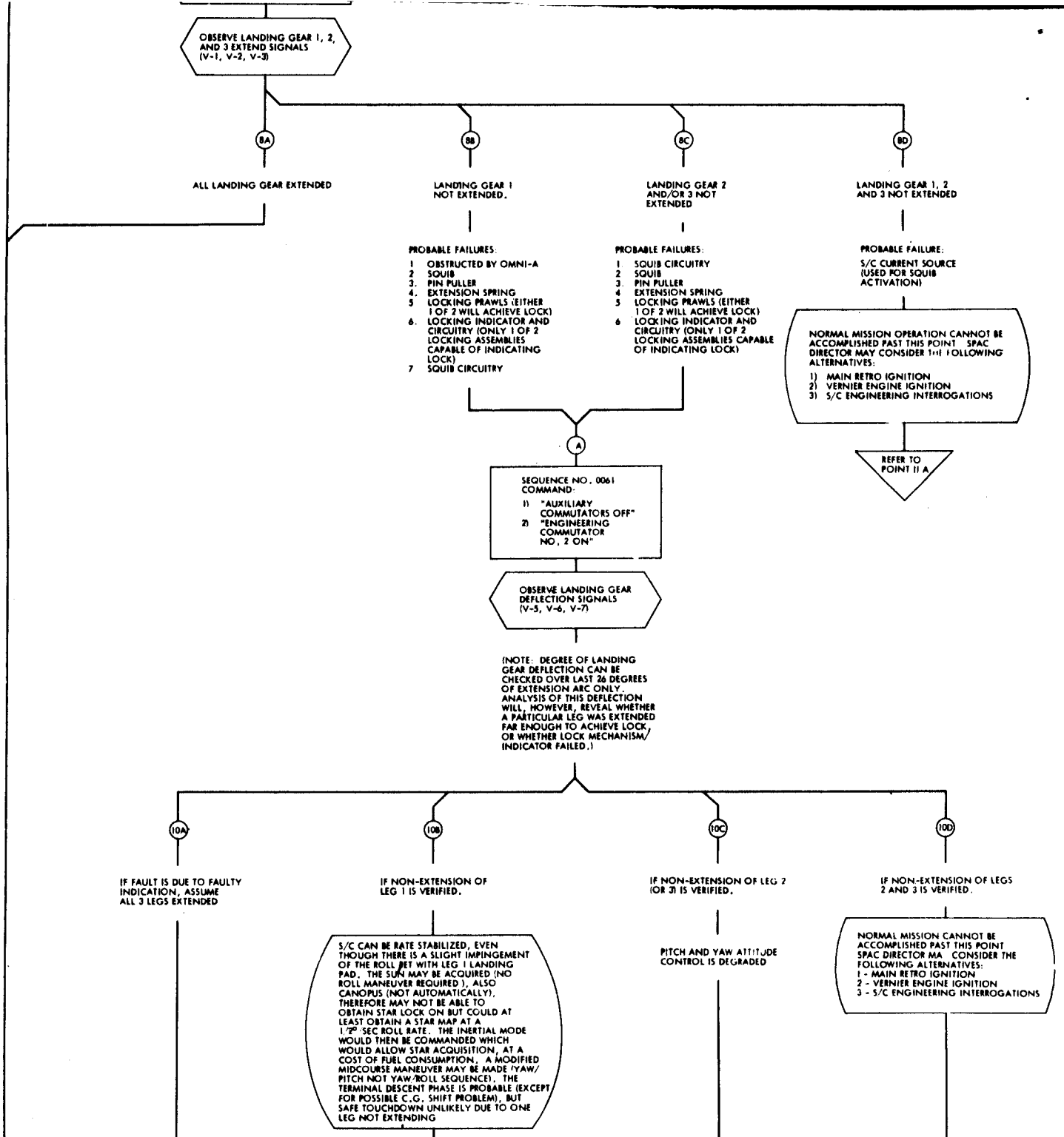
NOTE: A) INFORMATION THROUGH LEVEL 5 WILL BE FURNISHED BY SPAC
B) USE EDIT MODE 12 IF LINE TO SFOF CANNOT ACCOMMODATE 550 bps.

REQUIRED INSTRUMENTATION

| | |
|---|---|
| 1) LANDING GEAR 1, 2, 3 EXTENSION SIGNALS (V-1, V-2, V-3) | CENTAUR TM, MODES 1, 2, 4, C, T |
| 2) LANDING GEAR DEFLECTION SIGNALS (V-5, V-6, V-7) | MODE 2 |
| 3) OMNI-ANTENNA A AND B EXTENSION SIGNALS (M-1, M-2) | CENTAUR TM, MODES 4, C, T |
| 4) VEHICLE SEPARATION (M-9) | CENTAUR TM, MODES 1, 2, 4, C, T |




(4)
4A
OBSERVE OMNI-ANTENNA A AND B EXTENSION SIGNALS (M-1, M-2) VIA S-BAND AND CENTAUR TM
(5)
5A
5B
5C
5D
5E
BOTH OMNI-ANTENNA EXTENDED
NO TM AVAILABLE
OMNI-B EXTENDED OMNI-A NOT EXTENDED
OMNI-B NOT EXTENDED OMNI-A EXTENDED
BOTH OMNI-A AND B DID NOT EXTEND
ACQUISITION PROCEDURES MAY BE MODIFIED SINCE ONLY OMNI-B IS ASSUMED TO HAVE EXTENDED
ACQUISITION PROCEDURES MAY BE MODIFIED SINCE ONLY OMNI-A IS ASSUMED TO HAVE EXTENDED.
ACQUISITION PROCEDURES MAY BE MODIFIED SINCE NEITHER OMNI IS ASSUMED TO HAVE EXTENDED
ATTEMPT DSIF ACQUISITION
(6)
6A
6B
ACQUISITION ACCOMPLISHED
ACQUISITION NOT ACCOMPLISHED
REFER TO NSP-7, S/C-DSIF, ONE-WAY ACQUISITION AT PT. 1A
OBSERVE LANDING GEAR 1, 2, AND 3 EXTEND SIGNALS VIA S/C-DSIF TM, (V-1, V-2, V-3)
(7)
7A
7B
7C
LANDING GEAR 1, 2 AND 3 EXTENDED
LANDING GEAR 1 NOT EXTENDED
LANDING GEAR 1 EXTENDED - LANDING GEAR 2 AND/OR 3 NOT EXTENDED
OBSERVE OMNI-ANTENNA A EXTENSION SIGNAL (M-1)
IT SHOULD BE NOTED THAT A CRITICAL SITUATION EXISTS IF OMNI-A HAS EXTENDED BUT LANDING GEAR 1 HAS NOT, SINCE COLLISION WITH THE EXTENDED OMNI WILL OCCUR WHEN LANDING GEAR 1 EXTENDS. HOWEVER, THE CHOICE SHOULD BE MADE TO EXTEND THE LANDING GEAR EVEN THOUGH OMNI-A COULD BE BROKEN. IF SO, THE COAX CONNECTION AND LINE SHOULD REMAIN INTACT (THOUGH DANGLING), RESULTING IN DEGRADED OMNI-A OPERATION.
SEQUENCE NO. 0060
COMMAND:
"EXTEND LANDING GEAR"


OBSERVE LANDING GEAR 1, 2, AND 3 EXTEND SIGNALS (V-1, V-2, V-3)
8A
8B
8C
8D
ALL LANDING GEAR EXTENDED
LANDING GEAR 1 NOT EXTENDED.
LANDING GEAR 2 AND/OR 3 NOT EXTENDED
LANDING GEAR 1, 2 AND 3 NOT EXTENDED
PROBABLE FAILURES:
1 OBSTRUCTED BY OMNI-A
2 SQUIB
3. PIN PULLER
4. EXTENSION SPRING
5 LOCKING PAWLS (EITHER 1 OF 2 WILL ACHIEVE LOCK)
6. LOCKING INDICATOR AND CIRCUITRY (ONLY 1 OF 2 LOCKING ASSEMBLIES CAPABLE OF INDICATING LOCK)
7 SQUIB CIRCUITRY
PROBABLE FAILURES:
1 SQUIB CIRCUITRY
2 SQUIB
3. PIN PULLER
4 EXTENSION SPRING
5 LOCKING PAWLS (EITHER 1 OF 2 WILL ACHIEVE LOCK)
6 LOCKING INDICATOR AND CIRCUITRY (ONLY 1 OF 2 LOCKING ASSEMBLIES CAPABLE OF INDICATING LOCK)
PROBABLE FAILURE:
S/C CURRENT SOURCE (USED FOR SQUIB ACTIVATION)
NORMAL MISSION OPERATION CANNOT BE ACCOMPLISHED PAST THIS POINT SPAC DIRECTOR MAY CONSIDER THE FOLLOWING ALTERNATIVES:
1) MAIN RETRO IGNITION
2) VERNIER ENGINE IGNITION
3) S/C ENGINEERING INTERROGATIONS
REFER TO POINT II A
A
SEQUENCE NO. 0061 COMMAND:
1) "AUXILIARY COMMUTATORS OFF"
2) "ENGINEERING COMMUTATOR NO. 2 ON"
OBSERVE LANDING GEAR DEFLECTION SIGNALS (V-5, V-6, V-7)
(NOTE: DEGREE OF LANDING GEAR DEFLECTION CAN BE CHECKED OVER LAST 26 DEGREES OF EXTENSION ARC ONLY. ANALYSIS OF THIS DEFLECTION WILL, HOWEVER, REVEAL WHETHER A PARTICULAR LEG WAS EXTENDED FAR ENOUGH TO ACHIEVE LOCK, OR WHETHER LOCK MECHANISM/ INDICATOR FAILED.)
10A
10B
10C
10D
IF FAULT IS DUE TO FAULTY INDICATION, ASSUME ALL 3 LEGS EXTENDED
IF NON-EXTENSION OF LEG 1 IS VERIFIED.
IF NON-EXTENSION OF LEG 2 (OR 3) IS VERIFIED.
IF NON-EXTENSION OF LEGS 2 AND 3 IS VERIFIED.
S/C CAN BE RATE STABILIZED, EVEN THOUGH THERE IS A SLIGHT IMPINGEMENT OF THE ROLL JET WITH LEG 1 LANDING PAD. THE SUN MAY BE ACQUIRED (NO ROLL MANEUVER REQUIRED), ALSO CANOPUS (NOT AUTOMATICALLY), THEREFORE MAY NOT BE ABLE TO OBTAIN STAR LOCK ON BUT COULD AT LEAST OBTAIN A STAR MAP AT A 1/2° SEC ROLL RATE. THE INERTIAL MODE WOULD THEN BE COMMANDED WHICH WOULD ALLOW STAR ACQUISITION, AT A COST OF FUEL CONSUMPTION. A MODIFIED MIDCOURSE MANEUVER MAY BE MADE (YAW/ PITCH NOT YAW/ROLL SEQUENCE). THE TERMINAL DESCENT PHASE IS PROBABLE (EXCEPT FOR POSSIBLE C.G. SHIFT PROBLEM), BUT SAFE TOUCHDOWN UNLIKELY DUE TO ONE LEG NOT EXTENDING
PITCH AND YAW ATTITUDE CONTROL IS DEGRADED
NORMAL MISSION CANNOT BE ACCOMPLISHED PAST THIS POINT SPAC DIRECTOR MA CONSIDER THE FOLLOWING ALTERNATIVES:
1 - MAIN RETRO IGNITION
2 - VERNIER ENGINE IGNITION
3 - S/C ENGINEERING INTERROGATIONS

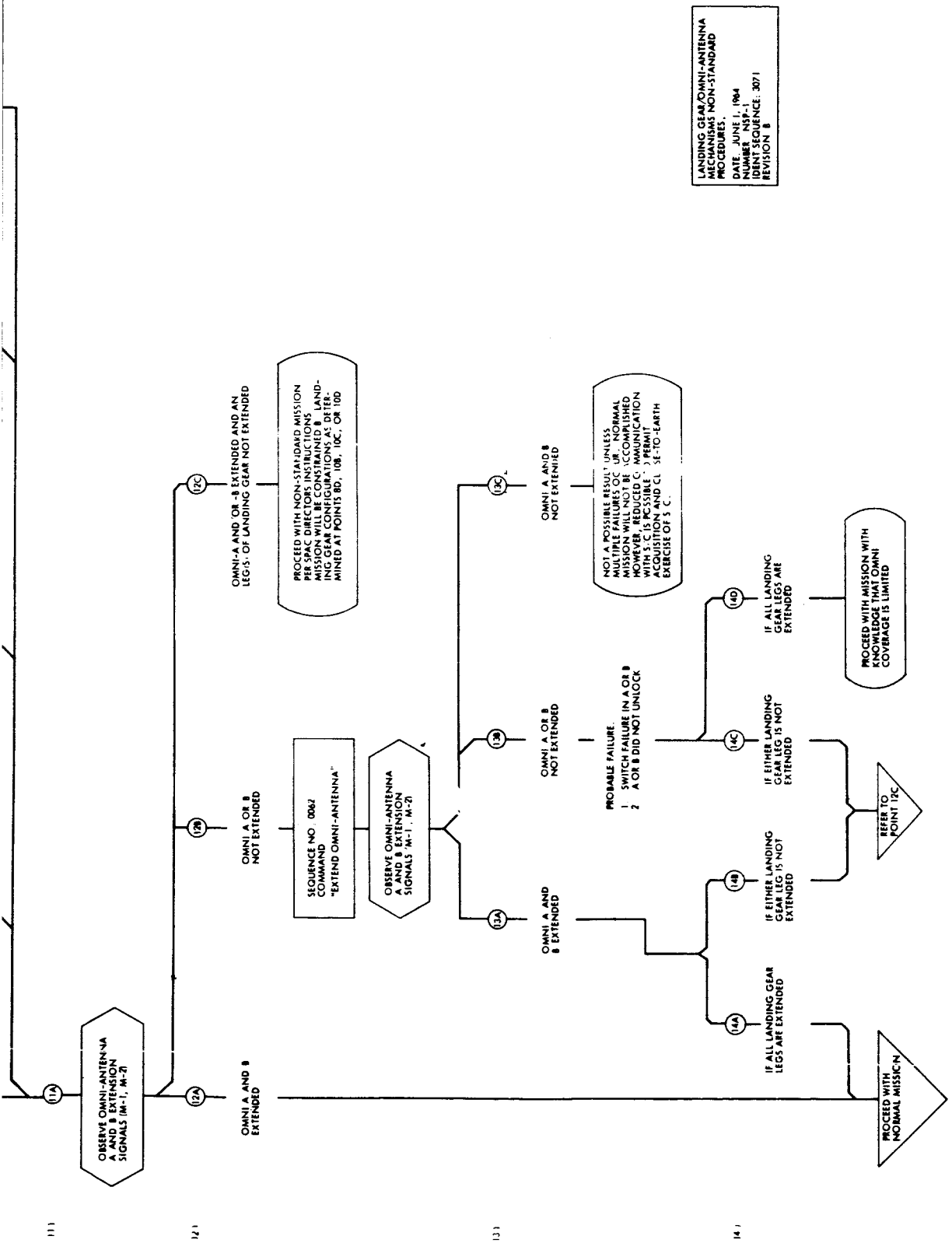



FIGURE VI-2. NSP-1, LANDING GEAR OMNIANTENNA MECHANISMS NONSTANDARD PROCEDURES

IDENTIFICATION SEQUENCE - 3073
NSP - 3, CENTAUR SEPARATION NON-STANDARD PROCEDURES

ASSUMPTIONS

1. NO CENTAUR DEBOOST
2. SHROUD EJECTED AT APPROXIMATELY 4 MIN. FROM LAUNCH
3. INJECTION WITHIN SPECIFICATION.
4. INITIAL MONITORING IS ON COAST MODE, 550 BPS.

NOTE: USE EDIT MODE 13 IF LINE TO SFOF CANNOT ACCOMODATE 550 BPS.

| MONITOR THE FOLLOWING SIGNALS: | MODE | DATA CHANNEL |
|---|---|---|
| 1. VEHICLE SEPARATION | 1, 2, 4, C | M-9 |
| 2. LANDING GEAR NO. 1, NO. 2, AND NO. 3 EXTENDED | 1, 2, 4, C, T | V-1, -2, -3 |
| 3. OMNI-ANTENNA A & B EXTENDED | 4, C, T | M-1,-2 |
| 4. CENTAUR-GENERATED SEPARATION SIGNAL | (CENTAUR TELEMETRY) | |
| 5. ROLL AXIS POSITION | 4, C | M-7 |
| 6. SOLAR PANEL POSITION | 4, C | M-3 |
| 7. SOLAR PANEL LOCKED IN TRANSIT POSITION | 1, 4, C, T | M-11 |
| 8. SUN MODE ON SIGNAL | 1, 2, 3, C, T | FC-59 |
| 9. PITCH AND YAW GYRO ERROR SIGNALS | 1, 2, 3, C, T | FC-16, -17 |
| 10. SECONDARY SUN SENSOR CELLS A, B, C, & D SIGNALS | 1, 2, C | FC-7, -8, -9, -10 |
| 11. COMPOSITE SUN SENSOR LOCKON | 1, 2, 4, C, T | FC-11 |
| 12. PRIMARY SUN SENSOR CENTER CELL LOCKON | 1, 2, 3, C, T | FC-69 |

-1-

(1A)

OBSERVE THE CENTAUR SEPARATION SIGNALS:
1. VEHICLE SEPARATION (M-9) GENERATED ON SURVEYOR AND TRANSMITTED TO AMR VIA CENTAUR TELEMETRY: AVAILABLE AT THE SFOF IN REAL TIME.
2. SEPARATION SIGNAL GENERATED ON CENTAUR AND TRANSMITTED TO AMR VIA CENTAUR TELEMETRY: AVAILABLE AT SFOF IN REAL TIME > 5 MINUTES.

-2-

(2A) SEPARATION OK INDICATED BY BOTH SIGNALS

(2B) NO DATA AVAILABLE OR ONE OR BOTH SIGNALS INDICATE NO SEPARATION (STORE THIS INFORMATION)

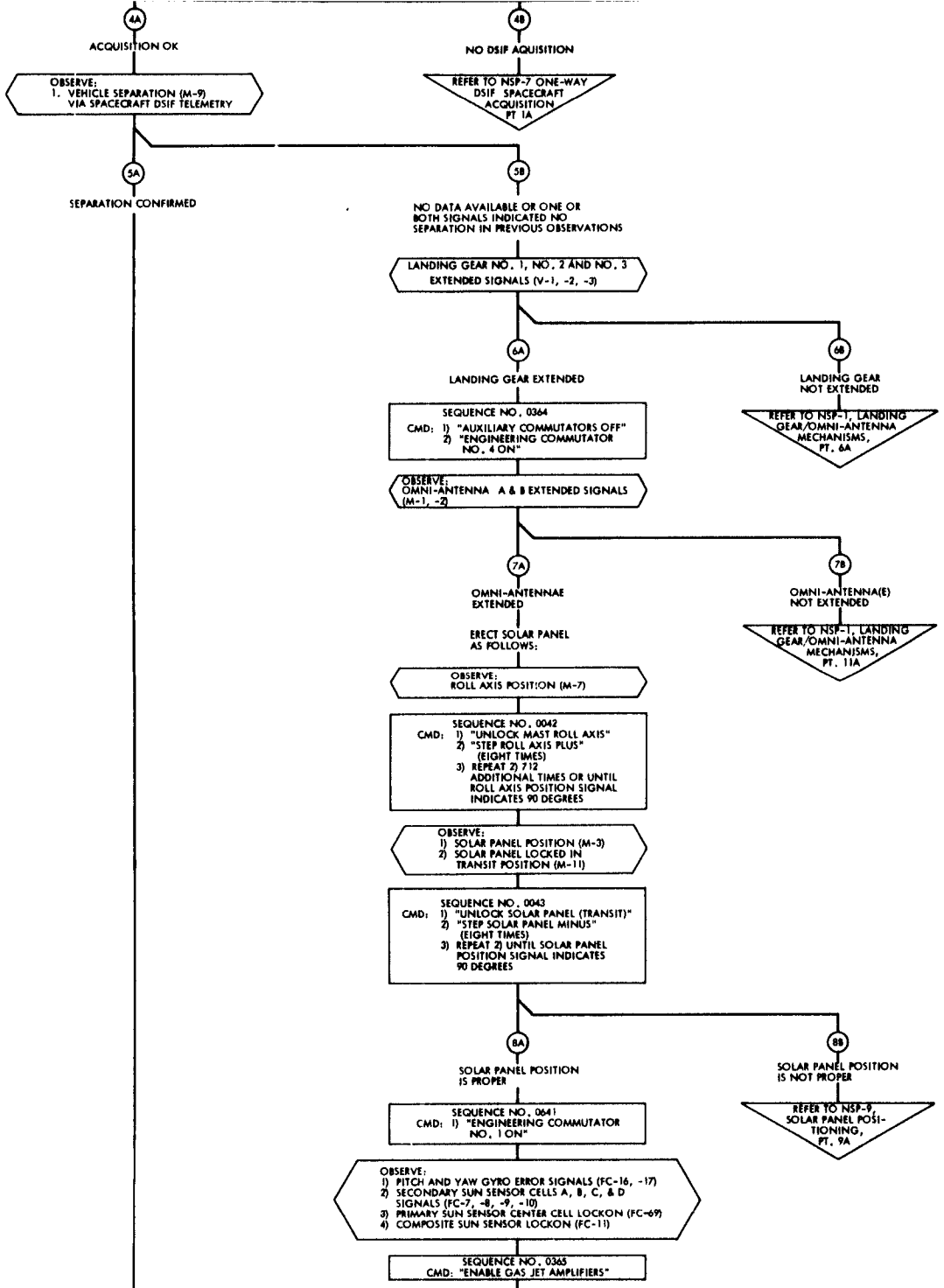
OBSERVE:
1. VEHICLE SEPARATION (M-9) VIA AMR DOWN RANGE S-BAND TELEMETRY
2. CENTAUR-GENERATED SEPARATION SIGNAL VIA AMR DOWNRANGE VHF TELEMETRY

-3-

(3A) SEPARATION CONFIRMED

(3B) NO DATA AVAILABLE OR ONE OR BOTH SIGNALS INDICATE NO SEPARATION (STORE THIS INFORMATION)

ATTEMPT DSIF ACQUISITION (PER DOP SECTION 2)


-4-
4A
ACQUISITION OK
OBSERVE:
1. VEHICLE SEPARATION (M-9)
VIA SPACECRAFT DSIF TELEMETRY
4B
NO DSIF AQUISITION
REFER TO NSP-7 ONE-WAY DSIF SPACECRAFT ACQUISITION PT 1A
-5-
5A
SEPARATION CONFIRMED
5B
NO DATA AVAILABLE OR ONE OR BOTH SIGNALS INDICATED NO SEPARATION IN PREVIOUS OBSERVATIONS
LANDING GEAR NO. 1, NO. 2 AND NO. 3 EXTENDED SIGNALS (V-1, -2, -3)
-6-
6A
LANDING GEAR EXTENDED
SEQUENCE NO. 0364
CMD: 1) "AUXILIARY COMMUTATORS OFF"
2) "ENGINEERING COMMUTATOR NO. 4 ON"
OBSERVE:
OMNI-ANTENNA A & B EXTENDED SIGNALS (M-1, -2)
6B
LANDING GEAR NOT EXTENDED
REFER TO NSP-1, LANDING GEAR/OMNI-ANTENNA MECHANISMS, PT. 6A
-7-
7A
OMNI-ANTENNAE EXTENDED
ERECT SOLAR PANEL AS FOLLOWS:
OBSERVE:
ROLL AXIS POSITION (M-7)
SEQUENCE NO. 0042
CMD: 1) "UNLOCK MAST ROLL AXIS"
2) "STEP ROLL AXIS PLUS" (EIGHT TIMES)
3) REPEAT 2) 7 12 ADDITIONAL TIMES OR UNTIL ROLL AXIS POSITION SIGNAL INDICATES 90 DEGREES
OBSERVE:
1) SOLAR PANEL POSITION (M-3)
2) SOLAR PANEL LOCKED IN TRANSIT POSITION (M-11)
SEQUENCE NO. 0043
CMD: 1) "UNLOCK SOLAR PANEL (TRANSIT)"
2) "STEP SOLAR PANEL MINUS" (EIGHT TIMES)
3) REPEAT 2) UNTIL SOLAR PANEL POSITION SIGNAL INDICATES 90 DEGREES
7B
OMNI-ANTENNA(E) NOT EXTENDED
REFER TO NSP-1, LANDING GEAR/OMNI-ANTENNA MECHANISMS, PT. 11A
-8-
8A
SOLAR PANEL POSITION IS PROPER
SEQUENCE NO. 0641
CMD: 1) "ENGINEERING COMMUTATOR NO. 1 ON"
OBSERVE:
1) PITCH AND YAW GYRO ERROR SIGNALS (FC-16, -17)
2) SECONDARY SUN SENSOR CELLS A, B, C, & D SIGNALS (FC-7, -8, -9, -10)
3) PRIMARY SUN SENSOR CENTER CELL LOCKON (FC-69)
4) COMPOSITE SUN SENSOR LOCKON (FC-11)
SEQUENCE NO. 0365
CMD: "ENABLE GAS JET AMPLIFIERS"
8B
SOLAR PANEL POSITION IS NOT PROPER
REFER TO NSP-9, SOLAR PANEL POSITIONING, PT. 9A

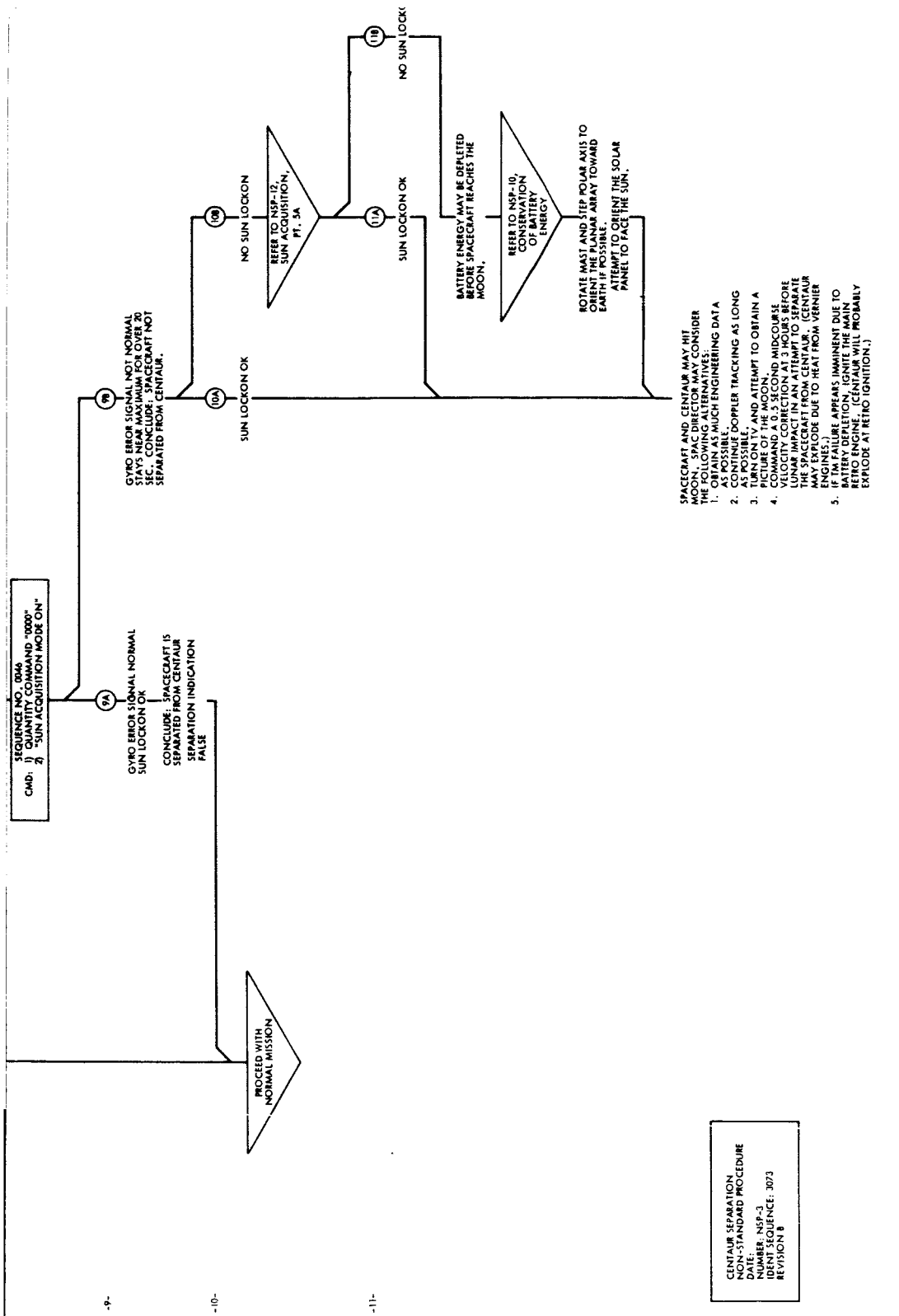



FIGURE VI-3. NSP-3, CENTAUR SEPARATION NONSTANDARD PROCEDURES

IDENTIFICATION SEQUENCE - 3077

NSP-7- S/C - DSIF ONE-WAY ACQUISITION NON-STANDARD PROCEDURE

ASSUMPTIONS:

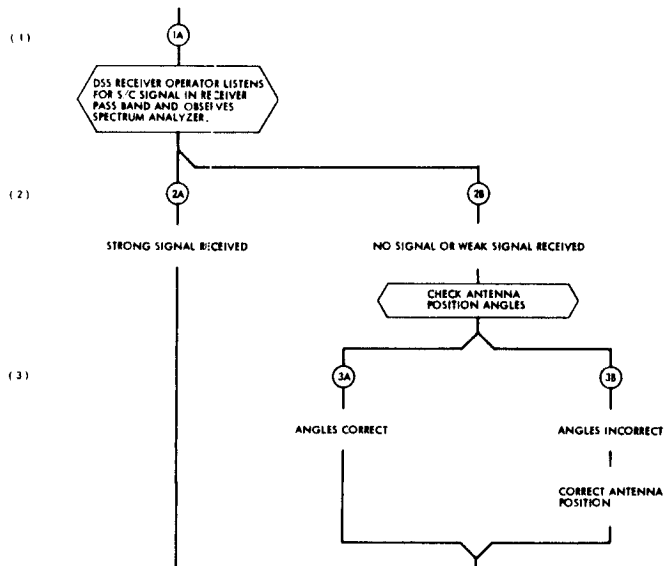
1) TRAJECTORY DATA FROM AMR TRACKING STATIONS AVAILABLE TO DSS.
2) RECEIVER B-TRANSPONDER B, NARROW BAND VCXO, TRANSMITTER B (LOW POWER MODE), ALL "ON" AT LAUNCH AND CONNECTED TO OMNI-ANTENNA B.
3) RECEIVER A AND TRANSMITTER A (FILAMENT) "ON" AT LAUNCH.
4) S/C TRANSMITTER UNDER VCXO CONTROL.
5) COAST PHASE COMMUTATOR "ON" AT LAUNCH.
6) DSIF CDC EQUIPMENT FUNCTIONING PROPERLY.
7) DSS ACQUISITION AID ANTENNA POINTED ACCORDING TO MODIFIED STANDARD TRAJECTORY DATA.
8) DSS RECEIVER AND TRANSMITTER SET TO FREQUENCIES UPGRADED TO ACCOUNT FOR DOPPLER SHIFT AND TEMPERATURE EFFECTS.

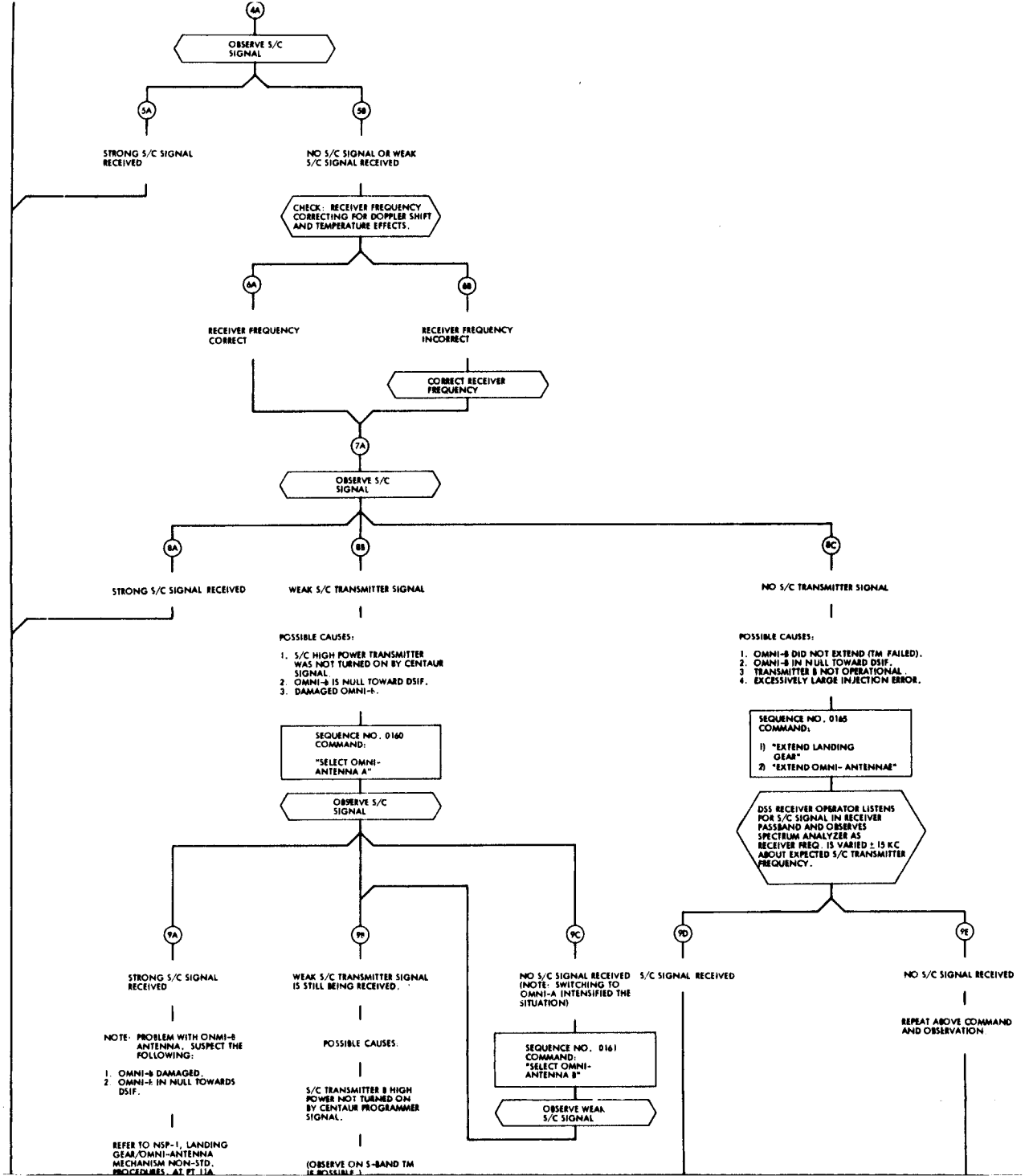
REQUIRED INSTRUMENTATION:

1) S/C AZIMUTH, ELEVATION, RANGE - AMR TM.
2) S/C TRANSMITTER FREQUENCY - - - - - STEA

SPECIAL NOTES:

1. THROUGHOUT THE ACQUISITION PROCEDURE, DSS OPERATOR MUST CONTINUALLY SEARCH ALONG THE PREDICTED (AND IF POSSIBLE, UPGRADED) TRAJECTORY, CONCURRENTLY MONITORING DSS RECEIVERS, AGC AND SPECTRUM ANALYZER FOR RECEIVED S/C SIGNAL.
2. WHENEVER BLIND COMMANDS ARE SENT, i.e., PRIOR TO ACQUISITION, EACH COMMAND, PRECEDED BY A MODULATION INTERRUPTION SHOULD BE SENT TWICE, EXCEPT WHERE OTHERWISE NOTED. ADDITIONALLY, THE DSS TRANSMITTER FREQUENCY IS VARIED ± 15 KCS ABOUT THE S/C RECEIVER FREQUENCY IN 5 KCS INCREMENTS FOR EACH SET OF TWO (2) COMMANDS AND MODULATION INTERRUPTIONS.




(4)
6A
OBSERVE S/C SIGNAL
(5)
5A
5B
STRONG S/C SIGNAL RECEIVED
NO S/C SIGNAL OR WEAK S/C SIGNAL RECEIVED
CHECK: RECEIVER FREQUENCY CORRECTING FOR DOPPLER SHIFT AND TEMPERATURE EFFECTS.
(6)
6A
6B
RECEIVER FREQUENCY CORRECT
RECEIVER FREQUENCY INCORRECT
CORRECT RECEIVER FREQUENCY
(7)
7A
OBSERVE S/C SIGNAL
(8)
8A
8B
8C
STRONG S/C SIGNAL RECEIVED
WEAK S/C TRANSMITTER SIGNAL
NO S/C TRANSMITTER SIGNAL
POSSIBLE CAUSES:
1. S/C HIGH POWER TRANSMITTER WAS NOT TURNED ON BY CENTAUR SIGNAL.
2. OMNI-b IS NULL TOWARD DSIF.
3. DAMAGED OMNI-b.
POSSIBLE CAUSES:
1. OMNI-B DID NOT EXTEND (TM FAILED).
2. OMNI-B IN NULL TOWARD DSIF.
3. TRANSMITTER B NOT OPERATIONAL.
4. EXCESSIVELY LARGE INJECTION ERROR.
SEQUENCE NO. 0160 COMMAND: "SELECT OMNI-ANTENNA A"
SEQUENCE NO. 0165 COMMAND: 1) "EXTEND LANDING GEAR" 2) "EXTEND OMNI- ANTENNAE"
OBSERVE S/C SIGNAL
DSS RECEIVER OPERATOR LISTENS FOR S/C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER AS RECEIVER FREQ. IS VARIED ± 15 KC ABOUT EXPECTED S/C TRANSMITTER FREQUENCY.
(9)
9A
9B
9C
9D
9E
STRONG S/C SIGNAL RECEIVED
WEAK S/C TRANSMITTER SIGNAL IS STILL BEING RECEIVED.
NO S/C SIGNAL RECEIVED (NOTE: SWITCHING TO OMNI-A INTENSIFIED THE SITUATION)
S/C SIGNAL RECEIVED
NO S/C SIGNAL RECEIVED
NOTE: PROBLEM WITH OMNI-B ANTENNA. SUSPECT THE FOLLOWING:
1. OMNI-b DAMAGED.
2. OMNI-b IN NULL TOWARDS DSIF.
POSSIBLE CAUSES.
SEQUENCE NO. 0161 COMMAND: "SELECT OMNI-ANTENNA B"
REPEAT ABOVE COMMAND AND OBSERVATION
OBSERVE WEAK S/C SIGNAL
S/C TRANSMITTER B HIGH POWER NOT TURNED ON BY CENTAUR PROGRAMMER SIGNAL.
REFER TO NSP-1, LANDING GEAR/OMNI-ANTENNA MECHANISM NON-STD. PROCEDURES, AT PT. 11A
(OBSERVE ON S-BAND TM IF POSSIBLE.)

2

FOR POST-ACQUISITION PROCEDURES.

SEQUENCE NO. 0163
COMMAND:

1) "TRANSFER SW B TO HIGH POWER"
2) "TRANSMITTER B HIGH VOLTAGE ON"

OBSERVE S/C SIGNAL

(10) (10A) STRONG S/C SIGNAL RECEIVED

(10B) S/C SIGNAL STILL WEAK

POSSIBLE CAUSES: TRANSMITTER B PERFORMANCE MARGINAL.

THE FOLLOWING SET OF 12 COMMANDS SHOULD BE SENT TWICE, EN MASSE, PRECEDED BY A MODULATION INTERRUPTION

SEQUENCE NO. 0163
COMMAND:

1) "TRANSMITTER LOW POWER OFF"
2) "TRANSMITTER B TO PLANAR ARRAY"
3) "TRANSMITTER A LOW POWER ON"
4) "NARROW BAND VCXO ON"
5) "TRANSPONDER POWER OFF"
6) "TRANSPONDER A POWER ON"
7) "TRANSMITTER FILAMENT POWER OFF"
8) "TRANSMITTER A FILAMENT POWER ON"
9) "SUMMING AMPLIFIER OFF"
10) "PRE-SUMMING AMPLIFIER ON"
11) "PHASE SUMMING AMPLIFIER A ON"
12) "TRANSFER SWITCH B LOW POWER"

DSS RECEIVER OPERATOR LISTENS FOR S/C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER.

(11) (11A) STRONG S/C SIGNAL RECEIVED WITHIN TWO MINUTES

(11B) NO S/C SIGNAL OR WEAK S/C SIGNAL RECEIVED WITHIN TWO MINUTES.

THE FOLLOWING SET OF COMMANDS SHOULD BE SENT TWICE EN MASSE, PRECEDED BY A MODULATION INTERRUPTION.

SEQUENCE NO. 0164
COMMAND:

1) "TRANSFER SWITCH A HIGH POWER"
2) "TRANSMITTER A HIGH VOLTAGE ON"

(12) DSS RECEIVER OPERATOR LISTENS FOR S/C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER.

(13) (13A) STRONG S/C SIGNAL RECEIVED.

(13B) NO S/C SIGNAL OR WEAK S/C SIGNAL RECEIVED.

REPEAT THE ABOVE SEQUENCE BEGINNING OF PT. 1A

(10C) S/C SIGNAL RECEIVED

(10D) NO S/C SIGNAL RECEIVED

SEQUENCE NO. 0160
COMMAND: "SELECT OMNI-ANTENNA A"

DSS RECEIVER OPERATOR LISTENS FOR S/C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER AS RECEIVER FREQ IS VARIED ± 15 KC ABOUT EXPECTED S/C TRANSMITTER FREQUENCY

(11C) S/C SIGNAL RECEIVED. (NOTE. PROBLEMS WITH OMNI-B ARE SUSPECTED HERE; MOST PROBABLY THE NULL ANTENNA PATTERN SITUATION EXISTS. S/C POSITIONING WOULD RECTIFY THIS LATER; AFTER ACQUISITION.)

(11D) NO S/C SIGNAL RECEIVED

REPEAT ABOVE COMMAND AND OBSERVATION

(12A) S/C SIGNAL RECEIVED

(12B) NO S/C SIGNAL RECEIVED

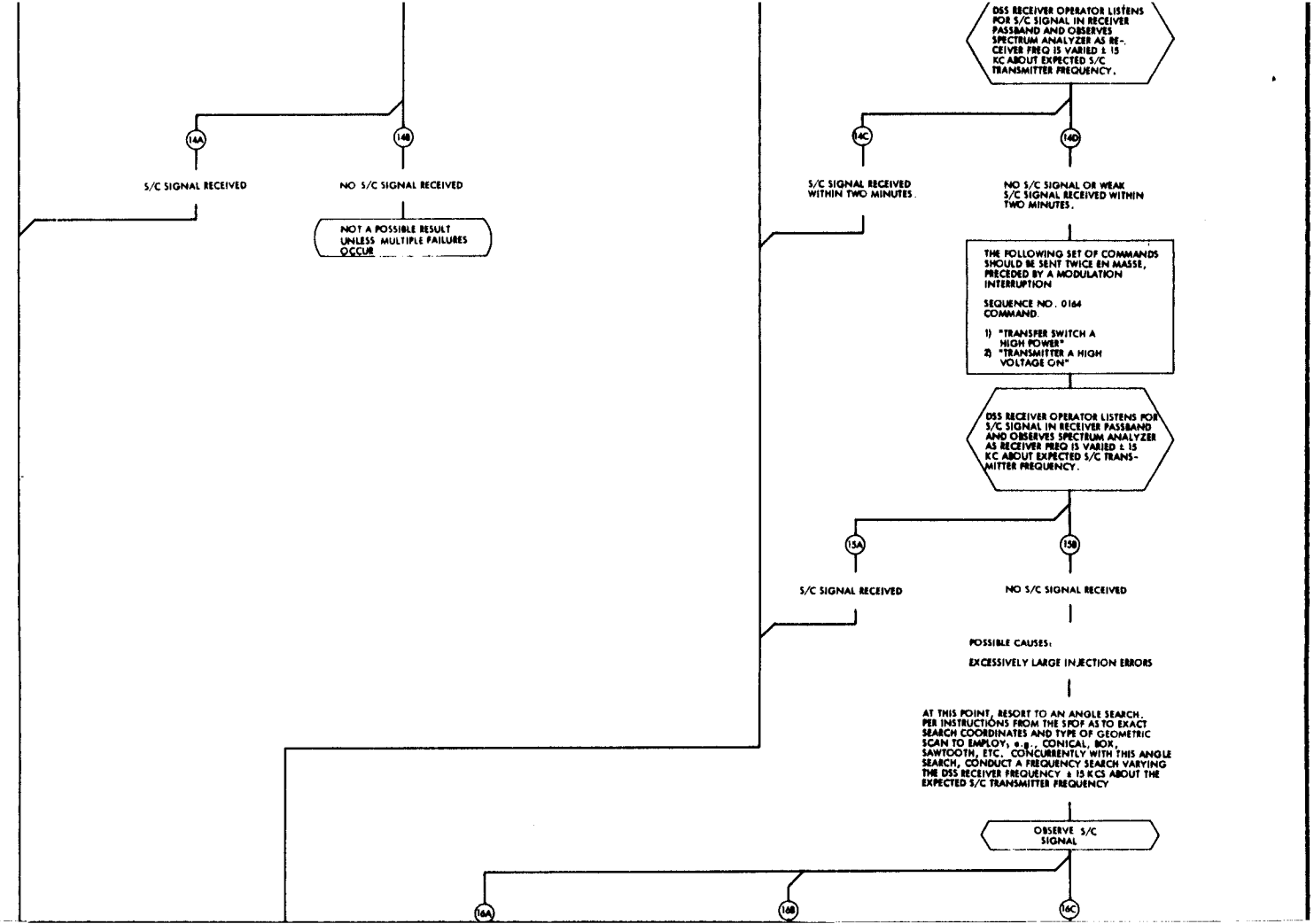
POSSIBLE CAUSES:

1. TRANSMITTER B NOT OPERATIONAL
2. EXCESSIVELY LARGE INJECTION ERRORS.

THE FOLLOWING SET OF 12 COMMANDS SHOULD BE SENT TWICE, EN MASSE, PRECEDED BY A MODULATION INTERRUPTION

SEQUENCE NO. 0163
COMMAND:

1) "TRANSMITTER LOW POWER OFF"
2) "TRANSMITTER B TO PLANAR ARRAY"
3) "TRANSMITTER A LOW POWER ON"
4) "NARROW BAND VCXO ON"
5) "TRANSPONDER POWER OFF"
6) "TRANSPONDER A POWER ON"
7) "TRANSMITTER FILAMENT POWER OFF"
8) "TRANSMITTER A FILAMENT POWER ON"
9) "SUMMING AMPLIFIERS OFF"
10) "PRE-SUMMING AMPLIFIER ON"
11) "PHASE SUMMING AMPLIFIER A ON"
12) "TRANSFER SWITCH B LOW POWER"


DSS RECEIVER OPERATOR LISTENS FOR S/C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER AS RECEIVER FREQ IS VARIED ± 15 KC ABOUT EXPECTED S/C TRANSMITTER FREQUENCY.
14C
14D
S/C SIGNAL RECEIVED WITHIN TWO MINUTES.
NO S/C SIGNAL OR WEAK S/C SIGNAL RECEIVED WITHIN TWO MINUTES.
THE FOLLOWING SET OF COMMANDS SHOULD BE SENT TWICE EN MASSE, PRECEDED BY A MODULATION INTERRUPTION
SEQUENCE NO. 0164
COMMAND
1) "TRANSFER SWITCH A HIGH POWER"
2) "TRANSMITTER A HIGH VOLTAGE ON"
DSS RECEIVER OPERATOR LISTENS FOR S/C SIGNAL IN RECEIVER PASSBAND AND OBSERVES SPECTRUM ANALYZER AS RECEIVER FREQ IS VARIED ± 15 KC ABOUT EXPECTED S/C TRANSMITTER FREQUENCY.
15A
15B
S/C SIGNAL RECEIVED
NO S/C SIGNAL RECEIVED
POSSIBLE CAUSES:
EXCESSIVELY LARGE INJECTION ERRORS
AT THIS POINT, RESORT TO AN ANGLE SEARCH. PER INSTRUCTIONS FROM THE SFOF AS TO EXACT SEARCH COORDINATES AND TYPE OF GEOMETRIC SCAN TO EMPLOY; e.g., CONICAL, BOX, SAWTOOTH, ETC. CONCURRENTLY WITH THIS ANGLE SEARCH, CONDUCT A FREQUENCY SEARCH VARYING THE DSS RECEIVER FREQUENCY ± 15 KCS ABOUT THE EXPECTED S/C TRANSMITTER FREQUENCY
OBSERVE S/C SIGNAL
16A
16B
16C
14A
14B
S/C SIGNAL RECEIVED
NO S/C SIGNAL RECEIVED
NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR
14)
15)
16)

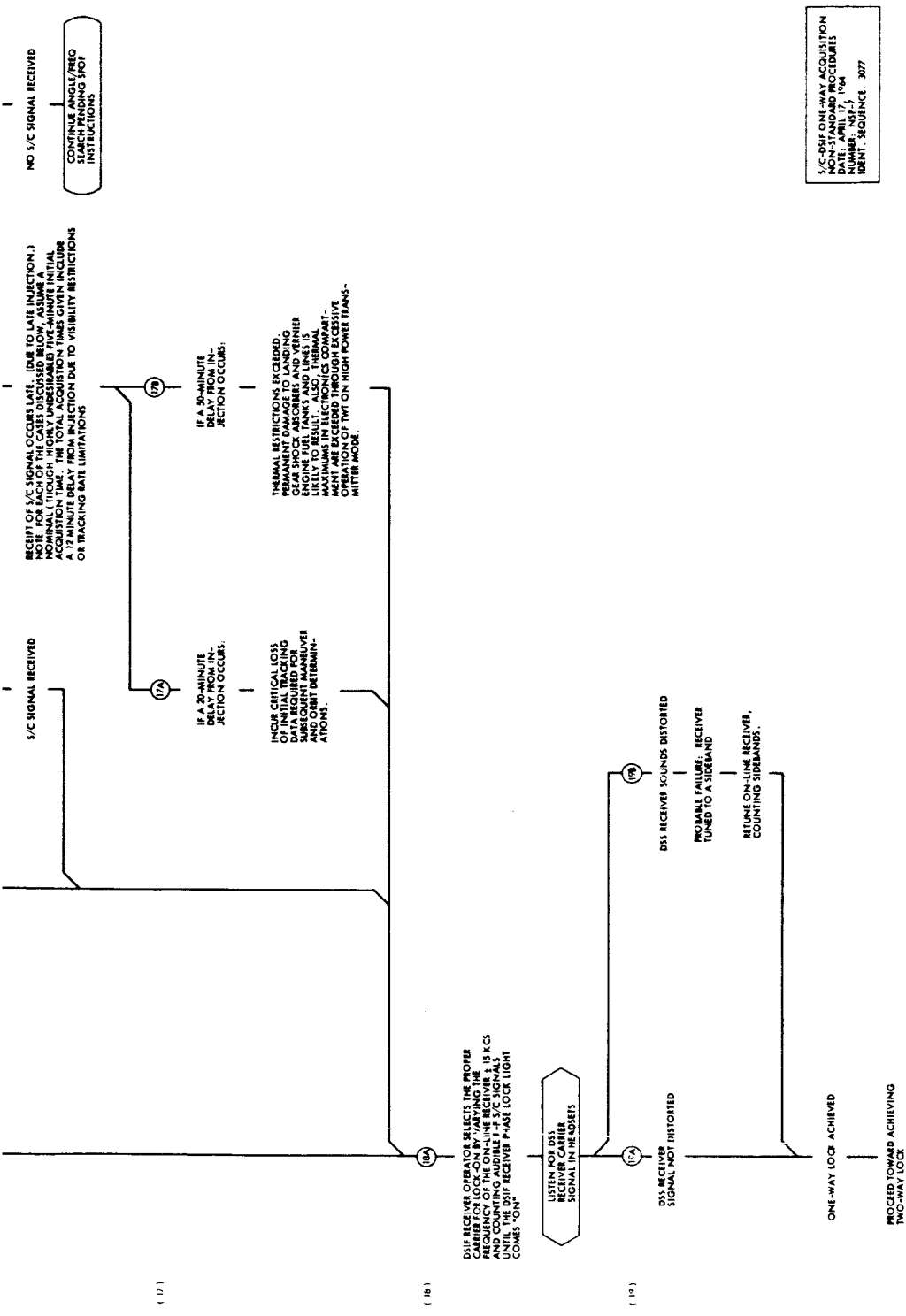



FIGURE VI-4. NSP-7-S/C-DSIF ONE-WAY ACQUISITION NONSTANDARD PROCEDURE

IDENTIFICATION SEQUENCE 3171
NSP, 9, SOLAR PANEL POSITIONING NON STANDARD PROCEDURES

ASSUMPTIONS:

1. NINETY DEGREE MAST ROTATION FOLLOWING LAUNCH HAS BEEN ACCOMPLISHED
2. DSIF ACQUISITION ACCOMPLISHED
3. COMMAND AND DATA CHANNELS FUNCTIONING PROPERLY

REQUIRED INSTRUMENTATION:

| | | |
|---|---|---|
| 1 | SOLAR PANEL POSITION SIGNAL (M-3) | MODE 4, C |
| 2 | SOLAR PANEL LOCKED IN TRANSIT POSITION (M-11) | MODE 1, 4, C, T |
| 3 | COMPOSITE SUN SENSOR LOCKON SIGNAL (FC-11) | MODE 1, 2, 4, C, T |
| 4 | PRIMARY SUN SENSOR CENTER CELL LOCKON (FC-69) | MODE 1, 2, 4, C, T |
| 5 | PRIMARY SUN SENSOR PITCH AND YAW GYRO ERROR SIGNALS (FC-5 AND FC-6) | MODE 1, C |
| 6 | SECONDARY SUN SENSOR CELLS A, B, C AND D SIGNALS (FC-7, FC-8, FC-9 AND FC-10) | MODE 1, 2, C |

NOTE: USE EDIT MODE 14

(1)

(1A)

SEQUENCE NO. 0043
COMMAND:
1) "UNLOCK SOLAR PANEL (TRANSIT)"
2) "STEP SOLAR PANEL MINUS" (10 TIMES)

OBSERVE SOLAR PANEL POSITION SIGNAL (M-3)

(2)

(2A)

SOLAR PANEL STEPS NORMALLY (0.125 deg/cmd)

(2B)

NO SOLAR PANEL MOTION INDICATED

PROBABLE FAILURE:
1. LOCK MECHANISM
2. STEPPING MECHANISM
3. POSITION INDICATOR
4. TM FAILURE

SEQUENCE NO. 0043
COMMAND:
1) "UNLOCK SOLAR PANEL (TRANSIT)"
2) "STEP SOLAR PANEL MINUS (680 TIMES)

OBSERVE SOLAR PANEL POSITION SIGNAL (M-3)

(3)

(3A)

SEQUENCE NO. 0063
COMMAND:
"STEP SOLAR PANEL MINUS" (680 TIMES)

(3B)

SOLAR PANEL STEPS NORMALLY (0.125 deg/cmd)

(3C)

SOLAR PANEL MOTION INCORRECT OR NO SOLAR PANEL MOTION INDICATED

PROBABLE FAILURE:
1. LOCK MECHANISM
2. STEPPING MECHANISM
3. POSITION INDICATOR
4. TM FAILURE

OBSERVE "SOLAR PANEL LOCKED IN TRANSIT POSITION" SIGNAL (M-11)

OBSERVE "SOLAR PANEL LOCKED IN TRANSIT POSITION" SIGNAL (M-11)

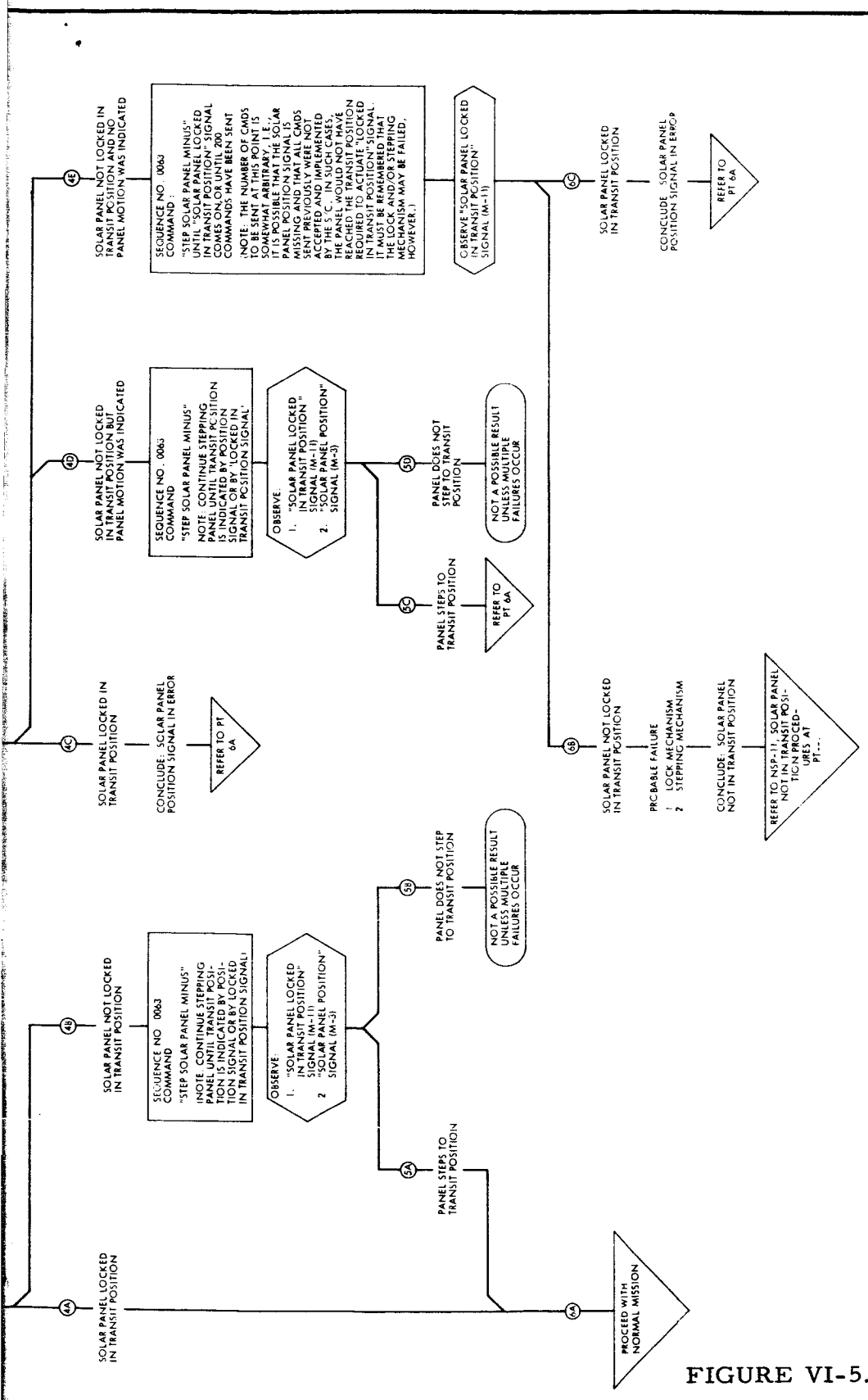
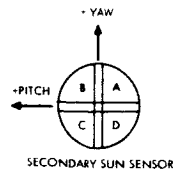



FIGURE VI-5. NSP-9, SOLAR PANEL POSITIONING NONSTANDARD PROCEDURES

IDENTIFICATION SEQUENCE 3174
NSP-12 SUN AQUISITION NONSTANDARD PROCEDURE

ASSUMPTIONS:

1. SPACECRAFT ACQUIRED BY DSIF AND TWO-WAY COMMUNICATIONS ESTABLISHED
2. SOLAR PANEL IN TRANSIT POSITION
3. INITIAL MONITORING IS ON ENGINEERING MODE 1,550 BPS




SECONDARY SUN SENSOR

REQUIRED INSTRUMENTATION

| | MODE |
|---|---|
| 1. COMPOSITE SUN LOCK-ON SIGNAL | - - - 1, 2, 4, C, T |
| 2. SECONDARY SUN SENSOR CELL SIGNALS | - - - 1, 2, C |
| 3. PRIMARY SUN SENSOR PITCH AND YAW ERROR SIGNALS | - - - 1, C |
| 4. PITCH AND YAW GYRO ERROR SIGNALS | - - - 1, 2, 3, C, T |
| 5. PRIMARY SUN SENSOR LOCK-ON SIGNAL | - - - 1, 2, 3, C, T |
| 6. SUN MODE SIGNAL | - - - 1, 2, 3, C, T |
| 7. PITCH AND YAW GYRO PRECESSION COMMANDS | - - - 2, C, T |
| 8. SOLAR CELL ARRAY VOLTAGE | - - - 2, 4, C |

NOTE:
USE EDIT MADE 13 IF LINE TO SFOF CANNOT ACCOMODATE 550 BPS.

-1-

(1A)

SEQUENCE NO. 0046
1. QUANTITY COMMAND "0000"
2. "SUN ACQUISITION MODE ON"

OBSERVE: SUN MODE ON SIGNAL (FC-59)

-2-

(2A) SUN MODE INDICATED

(2B) SUN MODE NOT INDICATED

OBSERVE:
1. GYRO ERROR SIGNALS (FC-16, -17)
2. SECONDARY SUN SENSOR CELL SIGNALS (FC-7, -8, -9, -10)
3. PRIMARY SUN SENSOR LOCKON SIGNAL (FC-69)
4. COMPOSITE SUN SENSOR LOCKON SIGNAL (FC-11)

-3-

(3A) NO SUN ACQUISITION INDICATED

CONCLUDE FAILURE IN FLIGHT CONTROL PROGRAMMER OR SUBSYSTEM DECODER

REFER TO NSP-6, FLIGHT CONT. PGMR, PT.: --

(3B) SUN ACQUISITION INDICATED

CONCLUDE: SUN MODE SIGNAL (FC-59) FALSE

OBSERVE:
GYRO ERROR SIGNALS (FC-16, 17)
VERIFY PROPER PERFORMANCE OF FLIGHT CONTROL

-4-

(4A) SPACECRAFT MANEUVERING AS INDICATED BY THE ABOVE

(4B) SPACECRAFT NOT MANEUVERING AS INDICATED BY THE ABOVE

OBSERVE:
1. COMPOSITE LOCKON SIGNAL (FC-11)
2. PRIMARY SUN SENSOR LOCKON SIGNAL (FC-69)

-5-

(5A)

OBSERVE:
1. COMPOSITE LOCK-ON SIGNAL (FC-11)
2. PRIMARY SUN SENSOR LOCK-ON (FC-69)

(5B) LOCKON INDICATED BY ONE SIGNAL

(5C) LOCKON INDICATED BY BOTH SIGNALS

RETURN TO POINT 11A

(5D) NO LOCKON INDICATED BY EITHER SIGNAL

REFER TO NSP 4 FLIGHT CONTROL COAST PHASE, PT . . .

-6-

(6A) SUN LOCK-ON INDICATED BY BOTH SIGNALS WITHIN 12 MINUTES.

(6B) NO SUN LOCK-ON AFTER 12 MINUTES

SEQUENCE NO. 0267
CMD: 1) "ENGINEERING COMMUTATOR NO. 2 ON"

OBSERVE:
PITCH AND YAW GYRO PRECESSION COMMAND RECORDINGS (FC-50 & 51)

SEQUENCE NO. 0641
CMD: 1) "ENGINEERING COMMUTATOR NO. 1 ON"

OBSERVE:
PITCH AND YAW GYRO ERROR SIGNAL RECORDINGS (FC-16, -17)

-7-

(7A) SPACECRAFT MANEUVERED AND STOPPED

OBSERVE: PRIMARY SUN SENSOR PITCH AND YAW ERROR RECORDINGS (FC-5, -6)

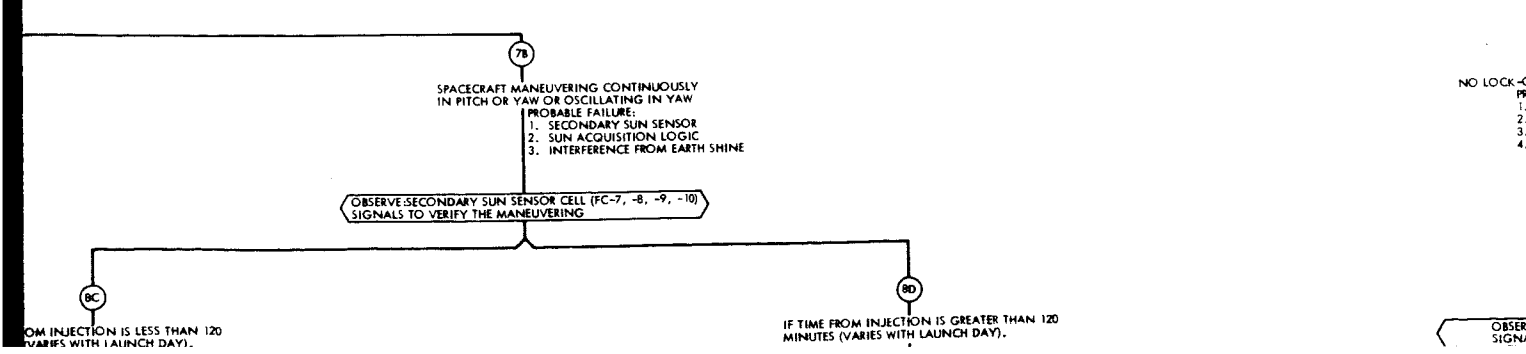
-8-

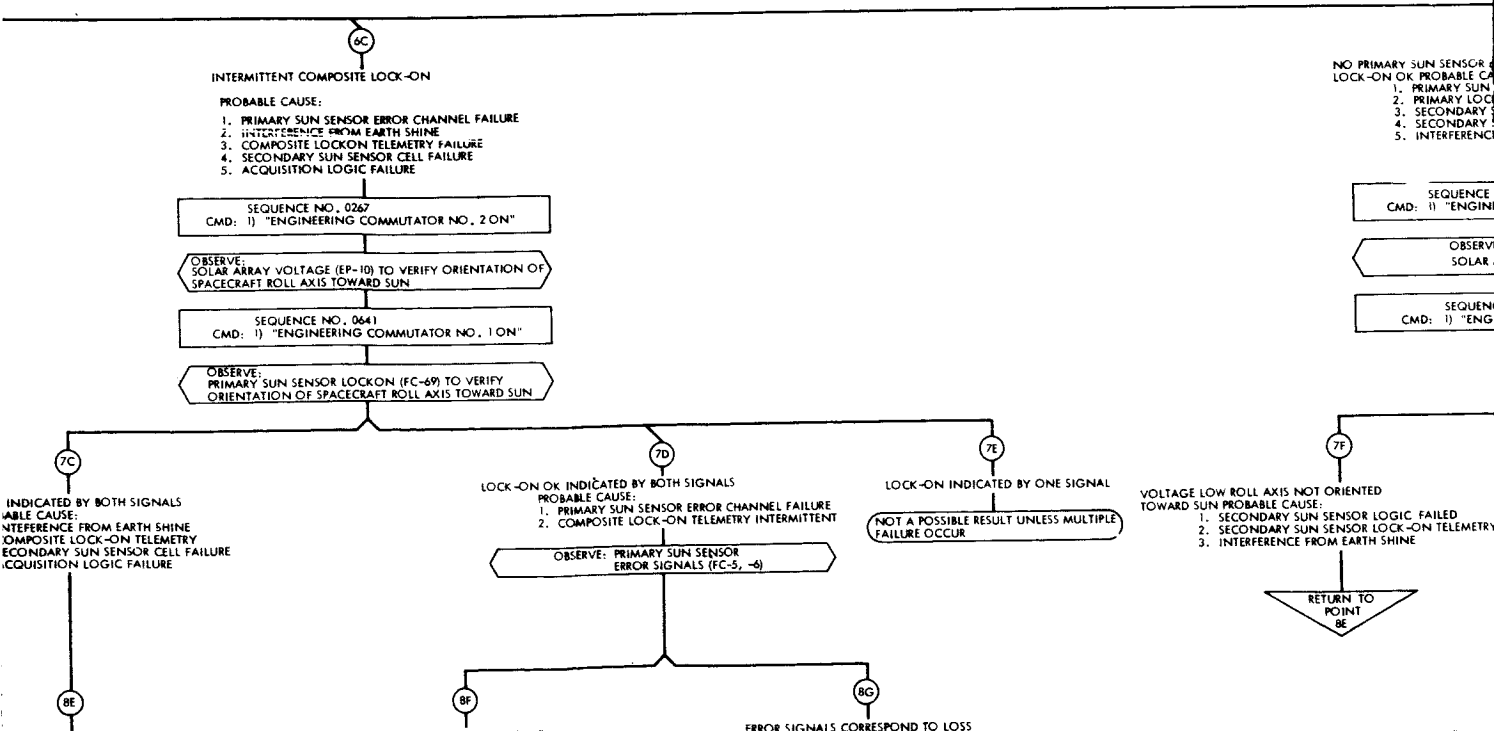
(8A) ERROR SIGNALS WENT TO A MAXIMUM AND RETURNED TO ZERO

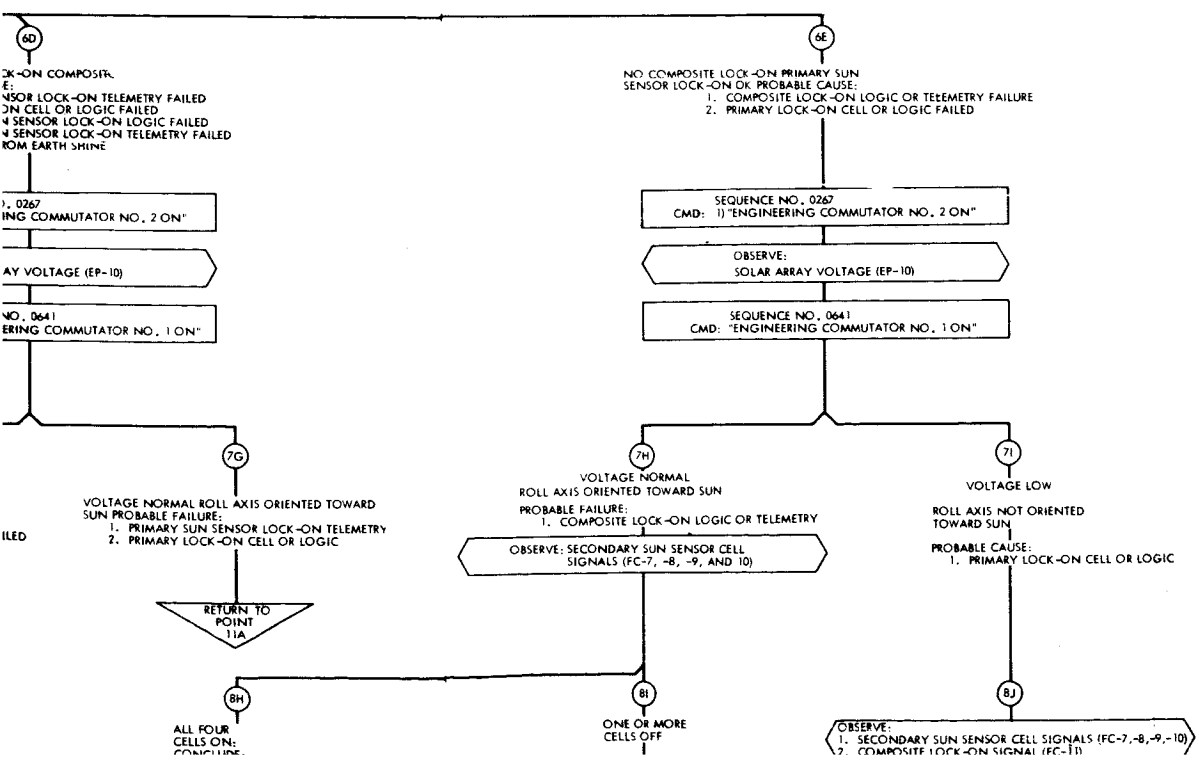
(8B) ERROR SIGNALS REMAINED CONSTANT INDICATES ROLL AXIS NOT POINTED TOWARD SUN

IF TIME F
MINUTES

DATA CHANNEL NO.
FC-11
FC-7, -8, -9, -10
FC-5, -6
FC-16, -17.
FC-69
FC-59
FC-50, -51
EP-10




6C
INTERMITTENT COMPOSITE LOCK-ON
PROBABLE CAUSE:
1. PRIMARY SUN SENSOR ERROR CHANNEL FAILURE
2. INTERFERENCE FROM EARTH SHINE
3. COMPOSITE LOCKON TELEMETRY FAILURE
4. SECONDARY SUN SENSOR CELL FAILURE
5. ACQUISITION LOGIC FAILURE
SEQUENCE NO. 0267
CMD: 1) "ENGINEERING COMMUTATOR NO. 2 ON"
OBSERVE:
SOLAR ARRAY VOLTAGE (EP-10) TO VERIFY ORIENTATION OF SPACECRAFT ROLL AXIS TOWARD SUN
SEQUENCE NO. 0641
CMD: 1) "ENGINEERING COMMUTATOR NO. 1 ON"
OBSERVE:
PRIMARY SUN SENSOR LOCKON (FC-69) TO VERIFY ORIENTATION OF SPACECRAFT ROLL AXIS TOWARD SUN
7C
INDICATED BY BOTH SIGNALS
ABLE CAUSE:
NTEFERENCE FROM EARTH SHINE
OMPOSITE LOCK-ON TELEMETRY
ECONDARY SUN SENSOR CELL FAILURE
CQUISITION LOGIC FAILURE
8E
7D
LOCK-ON OK INDICATED BY BOTH SIGNALS
PROBABLE CAUSE:
1. PRIMARY SUN SENSOR ERROR CHANNEL FAILURE
2. COMPOSITE LOCK-ON TELEMETRY INTERMITTENT
OBSERVE: PRIMARY SUN SENSOR ERROR SIGNALS (FC-5, -6)
8F
8G
ERROR SIGNALS CORRESPOND TO LOSS
7E
LOCK-ON INDICATED BY ONE SIGNAL
NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURE OCCUR
NO PRIMARY SUN SENSOR
LOCK-ON OK PROBABLE CA
1. PRIMARY SUN
2. PRIMARY LOC
3. SECONDARY
4. SECONDARY
5. INTERFERENC
SEQUENCE
CMD: 1) "ENGINI
OBSERV
SOLAR
SEQUEN
CMD: 1) "ENG
7F
VOLTAGE LOW ROLL AXIS NOT ORIENTED TOWARD SUN PROBABLE CAUSE:
1. SECONDARY SUN SENSOR LOGIC FAILED
2. SECONDARY SUN SENSOR LOCK-ON TELEMETRY
3. INTERFERENCE FROM EARTH SHINE
RETURN TO POINT 8E


6D
6E
NO COMPOSITE LOCK-ON PRIMARY SUN SENSOR LOCK-ON OK PROBABLE CAUSE:
1. COMPOSITE LOCK-ON LOGIC OR TEEEMETRY FAILURE
2. PRIMARY LOCK-ON CELL OR LOGIC FAILED
SEQUENCE NO. 0267
CMD: 1) "ENGINEERING COMMUTATOR NO. 2 ON"
OBSERVE:
SOLAR ARRAY VOLTAGE (EP-10)
SEQUENCE NO. 0641
CMD: "ENGINEERING COMMUTATOR NO. 1 ON"
7G
7H
7I
VOLTAGE NORMAL ROLL AXIS ORIENTED TOWARD SUN PROBABLE FAILURE:
1. PRIMARY SUN SENSOR LOCK-ON TELEMETRY
2. PRIMARY LOCK-ON CELL OR LOGIC
VOLTAGE NORMAL
ROLL AXIS ORIENTED TOWARD SUN
PROBABLE FAILURE:
1. COMPOSITE LOCK-ON LOGIC OR TELEMETRY
OBSERVE: SECONDARY SUN SENSOR CELL SIGNALS (FC-7, -8, -9, AND 10)
VOLTAGE LOW
ROLL AXIS NOT ORIENTED TOWARD SUN
PROBABLE CAUSE:
1. PRIMARY LOCK-ON CELL OR LOGIC
RETURN TO POINT 11A
8H
8I
8J
ALL FOUR CELLS ON:
ONE OR MORE CELLS OFF
OBSERVE:
1. SECONDARY SUN SENSOR CELL SIGNALS (FC-7,-8,-9,-10)

5th

MIDDLE

6H

-9-

INDICATES ROLL AXIS POINTED TOWARD SUN
PROBABLE FAILURE:
LOCK-ON TELEMETRY

NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR

PROBABLE FAILURE:
1. SECONDARY SUN SENSOR
2. SUN ACQUISITION LOGIC
3. INTERFERENCE FROM EARTH SHINE

OBSERVE: SECONDARY SUN SENSOR CELL (FC-7, -8, -9 -10) SIGNALS TO VERIFY SPACECRAFT ATTITUDE.

9A

IF SP

SPA
TO

SEQUEN
CMD: 1) "INER
2) "MAN
3) "POSI
4) "YAW
SENS
5) "INER

-10-

10A

IF TIME FROM INJECTION IS LESS THAN 120 MINUTES (VARIES WITH LAUNCH DAY)

PROBABLE INTERFERENCE FROM EARTH BRIGHTNESS

10B

IF TIME FROM INJECTION IS GREATER THAN 120 (VARIES WITH LAUNCH DAY)

PROBABLE FAILURE:
1. SECONDARY SUN SENSOR
2. ACQUISITION LOGIC

-11-

11A

11B

REFER TO TABLE 1 (BELOW)

11C

REFER TO TABLE 3 (BELOW)

OBSERVE: PRIMARY SUN SENSOR PITCH AND YAW ERROR SIGNAL RECORDINGS (FC-5, -6)

-12-

12A

SUN LOCK-ON OBTAINED

RETURN TO POINT 11A

12B

NO SUN LOCK-ON

WAIT UNTIL 120 MINUTES AFTER INJECTION

RETURN TO POINT 1A

12C

SUN LOCK-ON SIGNAL OBTAINED

RETURN TO POINT 11A

NO SUN
SIGNAL

NOT A POSSIBLE RES
FAILURES OCCUR

-13-

13A

ERROR SIGNALS WENT TO A MAXIMUM AND RETURNED TO ZERO
VERIFIES REAL LOCK-ON

13B

BOTH ERROR SIGNALS ALWAYS ZER

PROBABLE CAUSE:
1. NORMAL LOCK-ON, ERRORS HAPPENED TO BE ZERO
2. LOCK-ON CIRCUIT FAILED, ROLL AXIS NOT POINTED TOWARD SUN
3. PRIMARY SUN SENSOR FAILED
4. SECONDARY SUN SENSOR FAILED
5. SUN ACQUISITION LOGIC FAILED

OBSERVE:
SECONDARY SUN SENSOR CELL SIGNALS (FC -7, -8, -9, -10)

ONE ERROR SIGN
NORMAL)

PROBABLE CAUSE:
1. NORMAL OPERATIO
2. ERROR SIGNAL TELE
3. THAT CHANNEL OF
4. FLIGHT CONTROL E
(SPACECRAFT
5. FLIGHT CONTROL L
DOES NOT MANEUV

EARTH BRIGHTNESS INTERFERENCE

9B

ECRAFT OSCILLATING IN YAW

ECRAFT PROBABLY ATTEMPTING
OCK ONTO EARTH

E NO. 0361
IAL MODE ON"
IAL DELAY MODE ON"
IVE ANGLE MANEUVER"
(UNTIL TWO OR MORE SECONDARY SUN
)R CELLS ARE ILLUMINATED)
IAL MODE ON"

RETURN TO POINT 11B

9C

IF SPACECRAFT MANEUVERING CONTINUOUSLY:

WHEN TWO OR MORE CELLS ARE ILLUMINATED

SEQUENCE NO. 1242
CMD: 1) "INERTIAL MODE ON"

1. SECONDARY SUN SENSOR
2. ACQUISITION LOGIC

REFER TO TABLE 2 (BELOW)

9D

SUN LOCK-ON SIGNAL OBTAINED

RETURN TO POINT 11A

9E

NO SUN LOCK-ON SIGNAL OBTAINED

NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR

9F

ALL 4 CELLS ON
PROBABLE FAILURE:
1. PRIMARY SUN SENSOR
2. INTERMITTENT TELEMETRY

OBSERVE: PRIMARY SUN SENSOR ERROR SIGNALS (FC-5 & -6)

MINUTES

10C

ERROR SIGNALS WENT TO A MAXIMUM AND RETURNED TO ZERO.

CONCLUDE: TELEMETRY FAILURE

10D

ERROR SIGNALS CONSTANT

CONCLUDE: PRIMARY SUN SENSOR FAILURE

PROCEED WITH MISSION USING MANUAL MODE AND SECONDARY SUN SENSOR CELL SIGNALS TO KEEP SPACECRAFT ROLL AXIS POINTED AT SUN

RETURN TO POINT 17A

TABLE 1 SUN ACQUISITION*MANEUVERS IN THE PRESENCE OF EARTH BRIGHTNESS INTERFERENCE

| | CELL ON | COMMAND** | RESULT | COMMAND** | RESULT | COMMAND | RESULT |
|---|---|---|---|---|---|---|---|
| | NONE OR ONE | SEE NSP 28 | | | | | |
| 1 | A D | +Y | C AND D ON<br>A AND B ON | -P*<br>+P* | LO<br>LO | | |
| 2 | A C | +Y | C OR A GOES OFF<br>A AND B ON | -Y<br>+P* | C AND D ON<br>LO | -P* | LO |
| 3 | A C D | +Y* | D GOES OFF<br>LO | -P* | LO | | |
| 4 | A B | +P | B AND C ON<br>A AND D ON | -Y*<br>+Y* | LO<br>LO | | |
| 5 | A B C | -Y*<br>LO | LO<br>B GOES OFF | +P* | LO | | |
| 6 | B D | +Y | C AND D ON<br>B OR D GOES OFF | -P*<br>-Y | LO<br>A AND B ON | +P* | LO |
| 7 | B C | -Y | C AND D ON<br>A AND B ON | -P*<br>+P* | LO<br>LO | | |
| 8 | B C D | -Y*<br>LO | LO<br>C GOES OFF | -P* | LO | | |
| 9 | A B D | +Y* | LO<br>A GOES OFF | +P* | LO | | |
| 10 | C D | -P | A AND D ON<br>B AND C ON | +Y*<br>-Y* | LO<br>LO | | |

TABLE 2 SUN ACQUISITION PROCED

| GYRO PRECESSION SIGNALS AND GYRO ERROR SIGNALS, INDICATE | SE |
|---|---|
| CONTINUOUS + YAW | CELL A GO<br>CELL D GO<br>CELL A AN<br>CELL C AN |
| CONTINOUS - YAW | CELL A AN<br>CELL C AN |
| YAW OSCILLATIONS | CELL B GO<br>CELL C GO<br>CELL B GO<br>CELL C GO |
| CONTINUOUS + PITCH | CELL B ANI<br>CELL B ANI<br>CELL A AN |
| CONTINUOUS - PITCH | CELL B ANI<br>CELL A AN |

TABLE 3 SUN ACQUISITION PROCE

| CELL ON | ** COMMAND | PROBABL FAILURE |
|---|---|---|
| NONE | SEE NSP 28 | |
| D | + YAW | LOGIC |
| C | -YAW | - - |
| C D | - PITCH* | LOGIC |
| B | - YAW | - - |
| B D | - - | - - |
| B C | - YAW * | - - |
| B C D | - - | CELL A |
| A | - YAW | LOGIC |
| A D | + YAW* | LOGIC |
| A C | - - | |
| A C D | - YAW* | CELL A O |
| A B | - PITCH* | LOGIC |
| A B D | + YAW* | CELL B O |
| A B C | - - | CELL D |

DCK-ON
BTAINED

LT UNLESS MULTIPLE

9

L ALWAYS ZERO (ONE

(ERROR HAPPENED TO BE ZERO)
ETRY OUTPUT FAILED
IMARY SUN SENSOR FAILED
CTRONICS FAILED
OES NOT MANEUVER)
GIC FAILED (SPACECRAFT
D)

13D

ONE ERROR SIGNAL NOT ZERO (ONE NORMAL)

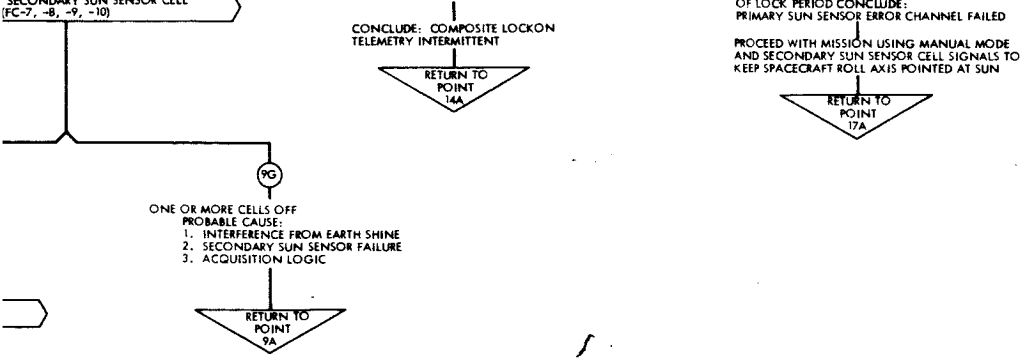
PROBABLE CAUSE:
1. BIAS IN FLIGHT CONTROL
2. BIAS IN TELEMETRY
3. TELEMETRY FAILED
4. THAT CHANNEL OF PRIMARY SUN SENSOR FAILED.
5. FLIGHT CONTROL ELECTRONICS FAILED (SPACECRAFT DOES NOT MANEUVER)
6. FLIGHT CONTROL LOGIC FAILURE (SPACECRAFT DOES NOT MANEUVER)

*WHEN SUN LOCK-ON SIGNAL APPEARS

SEQUENCE NO. 0046
CMD: 1) QUANTITY COMMAND "0000"
2) "SUN ACQUISITION MODE ON"

SUN ACQUISITION NONSTANDARD PROCEDURE
DATE:
NUMBER: NSP 12
IDENT. SER. 3174

** USE THE FOLLOWING SEQUENCE OF COMMANDS, BUT ONLY THE ONE MANEUVER COMMAND (ROLL, PITCH, OR YAW) CALLED OUT IN THE "COMMAND" COLUMN OF THE TABLE.



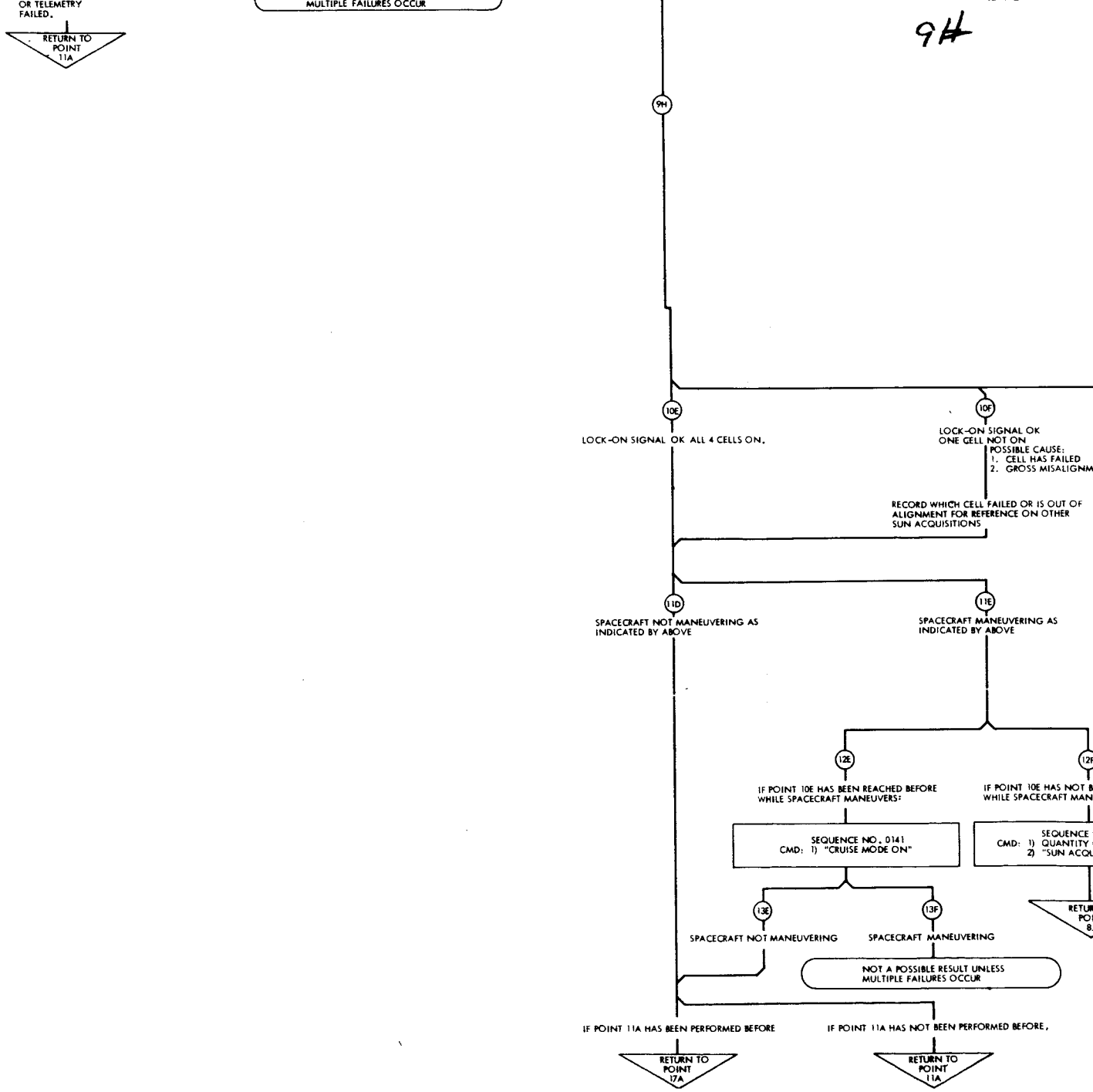

8 4

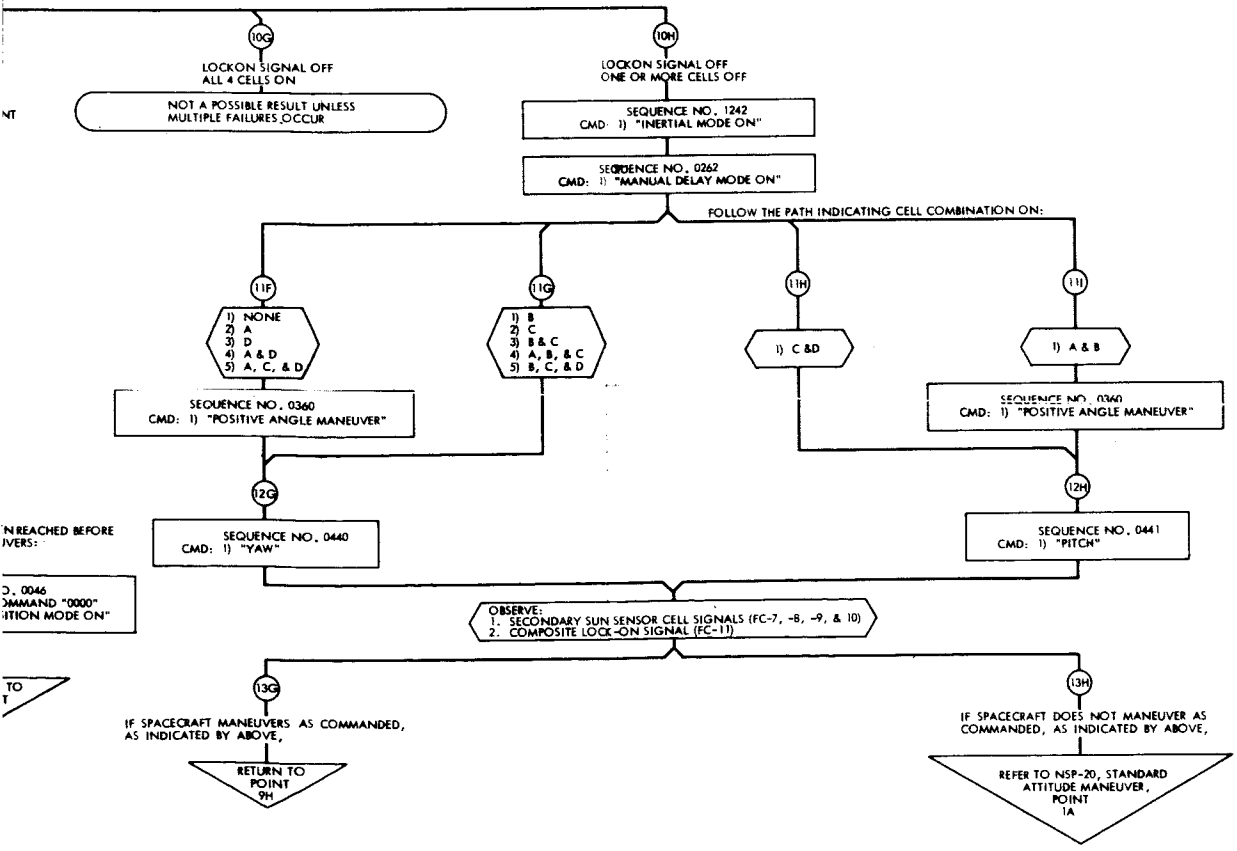
RE, SPACECRAFT MANEUVERING

| ONDARY SUN SENSOR INDICATION | WHEN CELL GOES OFF COMMAND** | PROBABLE FAILURE |
|---|---|---|
| S ON AND OFF, BOFF | A, + PITCH* | CELL B |
| S ON AND OFF, B OFF | D, - PITCH* | CELL C |
| B GOES ON AND OFF | A, + PITCH* | LOGIC |
| D GOES ON AND OFF | D, - PITCH* | LOGIC |
| B GOES ON AND OFF | B, + PITCH* | LOGIC |
| D GOES ON AND OFF | C, -PITCH* | LOGIC |
| S ON AND OFF, A OFF | B, + PITCH* | CELL A |
| S ON AND OFF, D OFF | C, - PITCH* | CELL D |
| S ON AND OFF, A ON | B, + PITCH* | LOGIC |
| S ON AND OFF, D ON | C, - PITCH* | LOGIC |
| C GOES ON AND OFF, A ON | B, - YAW* | CELL A |
| C GOES ON AND OFF, A OFF | B, - YAW* | LOGIC |
| D GOES ON AND OFF | A, + YAW* | LOGIC |
| C GOES ON AND OFF, D ON | C, -YAW* | CELL D |
| C GOES ON AND OFF, D OFF | C, - YAW* | LOGIC |
| D GOES ON AND OFF, B OFF | D, + YAW* | LOGIC |

URE, SPACECRAFT NOT MANEUVERING

| IF ANOTHER CELL GOES ON COMMAND** | IF CELL GOES OFF RETURN TO ORIGINAL ATTITUDE THEN COMMAND** |
|---|---|
| -PITCH* | - - |
| - PITCH* | - - |
| - - | - - |
| + PITCH* | - - |
| - - | - - |
| - - | - - |
| - - | - - |
| + PITCH* | - - |
| - - | - - |
| - - | - - |
| SUN MODE | - PITCH* |
| - - | - - |
| SUN MODE | + PITCH* |
| - - | - - |


OR TELEMETRY FAILED.
RETURN TO POINT 11A
MULTIPLE FAILURES OCCUR
9H
9H
10E
LOCK-ON SIGNAL OK ALL 4 CELLS ON.
10F
LOCK-ON SIGNAL OK
ONE CELL NOT ON
POSSIBLE CAUSE:
1. CELL HAS FAILED
2. GROSS MISALIGNM
RECORD WHICH CELL FAILED OR IS OUT OF ALIGNMENT FOR REFERENCE ON OTHER SUN ACQUISITIONS
11D
SPACECRAFT NOT MANEUVERING AS INDICATED BY ABOVE
11E
SPACECRAFT MANEUVERING AS INDICATED BY ABOVE
12E
IF POINT 10E HAS BEEN REACHED BEFORE WHILE SPACECRAFT MANEUVERS:
SEQUENCE NO. 0141
CMD: 1) "CRUISE MODE ON"
13E
SPACECRAFT NOT MANEUVERING
13F
SPACECRAFT MANEUVERING
NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR
IF POINT 11A HAS BEEN PERFORMED BEFORE
RETURN TO POINT 17A
IF POINT 11A HAS NOT BEEN PERFORMED BEFORE,
RETURN TO POINT 11A


10G
LOCKON SIGNAL OFF
ALL 4 CELLS ON
NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR
10H
LOCKON SIGNAL OFF
ONE OR MORE CELLS OFF
SEQUENCE NO. 1242
CMD: 1) "INERTIAL MODE ON"
SEQUENCE NO. 0262
CMD: 1) "MANUAL DELAY MODE ON"
FOLLOW THE PATH INDICATING CELL COMBINATION ON:
11F
1) NONE
2) A
3) D
4) A & D
5) A, C, & D
11G
1) B
2) C
3) B & C
4) A, B, & C
5) B, C, & D
11H
1) C &D
11I
1) A & B
SEQUENCE NO. 0360
CMD: 1) "POSITIVE ANGLE MANEUVER"
SEQUENCE NO. 0360
CMD: 1) "POSITIVE ANGLE MANEUVER"
12G
12H
SEQUENCE NO. 0440
CMD: 1) "YAW"
SEQUENCE NO. 0441
CMD: 1) "PITCH"
OBSERVE:
1. SECONDARY SUN SENSOR CELL SIGNALS (FC-7, -8, -9, & 10)
2. COMPOSITE LOCK-ON SIGNAL (FC-11)
13G
IF SPACECRAFT MANEUVERS AS COMMANDED, AS INDICATED BY ABOVE,
RETURN TO POINT 9H
13H
IF SPACECRAFT DOES NOT MANEUVER AS COMMANDED, AS INDICATED BY ABOVE,
REFER TO NSP-20, STANDARD ATTITUDE MANEUVER, POINT 1A

Bottom

11

-14-

14A

14B

ONE OR MORE CELLS OFF

PROBABLE FAILURE:
1. SECONDARY SUN SENSOR
2. SUN ACQUISITION LOGIC
3. LOCK-ON CIRCUIT FAILED

RETURN TO POINT 11 C

14C

IF ALL 4 CELLS ON

PROBABLE CAUSE
1 NORMAL LOCK-ON
2 PRIMARY SUN SENSOR FAILED

SEQUENCE NO. 0362
CMD: 1) "INERTIAL MODE ON"
2) "MANUAL DELAY MODE ON"
3) "YAW" FOR 5 SEC.
4) "POSITIVE ANGLE MANEUVER"
5) "YAW" FOR 5 SEC
6) " INERTIAL MODE ON"

14D

PITCH ERROR SIGNAL NOT ZERO

SEQUENCE NO. 0363
CMD: 1) "INERTIAL MODE ON"
2) "MANUAL DELAY MODE ON"
3) "PITCH" FOR 5 SEC
4) "POSITIVE ANGLE MANEUVER"
5) "PITCH" FOR 5 SEC
6) "INERTIAL MODE ON"

YAW ERRO
NOT ZERO

SEQUENCE
CMD: 1) "INERTIAL
2) "MANUAL
3) "YAW" FO
4) "POSITIVE
5) "YAW" FO
6) "INERTIA

OBSERVE: PRIMARY SUN SENSOR YAW ERROR SIGNAL TO DETERMINE IF LOOP IS CLOSED (FC-6)

OBSERVE: THE CORRESPONDING PRIMARY SUN SENSOR ERROR S
TO DETERMINE IF THE LOOP IS CLOSED (FC -5 OR -6)

-15-

15A

SIGNAL INCREASES

RETURN TO POINT 14 A

15B

SIGNAL REMAINS ZERO

PROBABLE CAUSES:
1. PRIMARY SUN SENSOR FAILED
2. SPACECRAFT DID NOT MANEUVER

OBSERVE: YAW GYRO ERROR SIGNAL RECORDING (FC-17)

15C

SIGNAL INCREASES

INDICATES LOOP CLOSED LOCK-ON OK

RETURN TO POINT 14 A

SIGNAL DOES

1. ERROR SIGNAL TELEMETRY
2. THAT CHANNEL OF PRIMA
3. FLIGHT CONTROL ELECTRO
4. FLIGHT CONTROL LOGIC

OBSERVE: GYRO ERROR SIGN
DETERMINE IF SPACECRAFT

OBSERVE: SECONDARY SUN SENSOR CELL SIGNALS (FC-7, -8, -9, -10)

-16-

IF ALL 4 CELLS ON SENSOR OK VERIFIES:
1. SECONDARY SUN SENSOR OK
2. NO SENSOR MISALIGNMENT

16A

IF ONE CELL NOT ON
POSSIBLE CAUSE:
1. THAT CELL HAS FAILED
2. GROSS MISALIGNMENT

RECORD WHICH CELL HAS FAILED OR IS OUT OF ALIGNMENT FOR REFERENCE ON OTHER SUN ACQUISITIONS

16B

SIGNAL VARIED
SPACECRAFT DID MANEUVER

PROBABLE CAUSE:
PRIMARY SUN SENSOR FAILED

MAINTAIN ORIENTATION OF SPACECRAFT ROLL AXIS TOWARD SUN BY MANUAL MANEUVERS USING SECONDARY SUN SENSOR CELL SIGNALS

REFER TO POINT 8J

SIGNAL REMAIN
SPACECRAFT DI

REFER TO
FLIGHT C
COAST
PT -

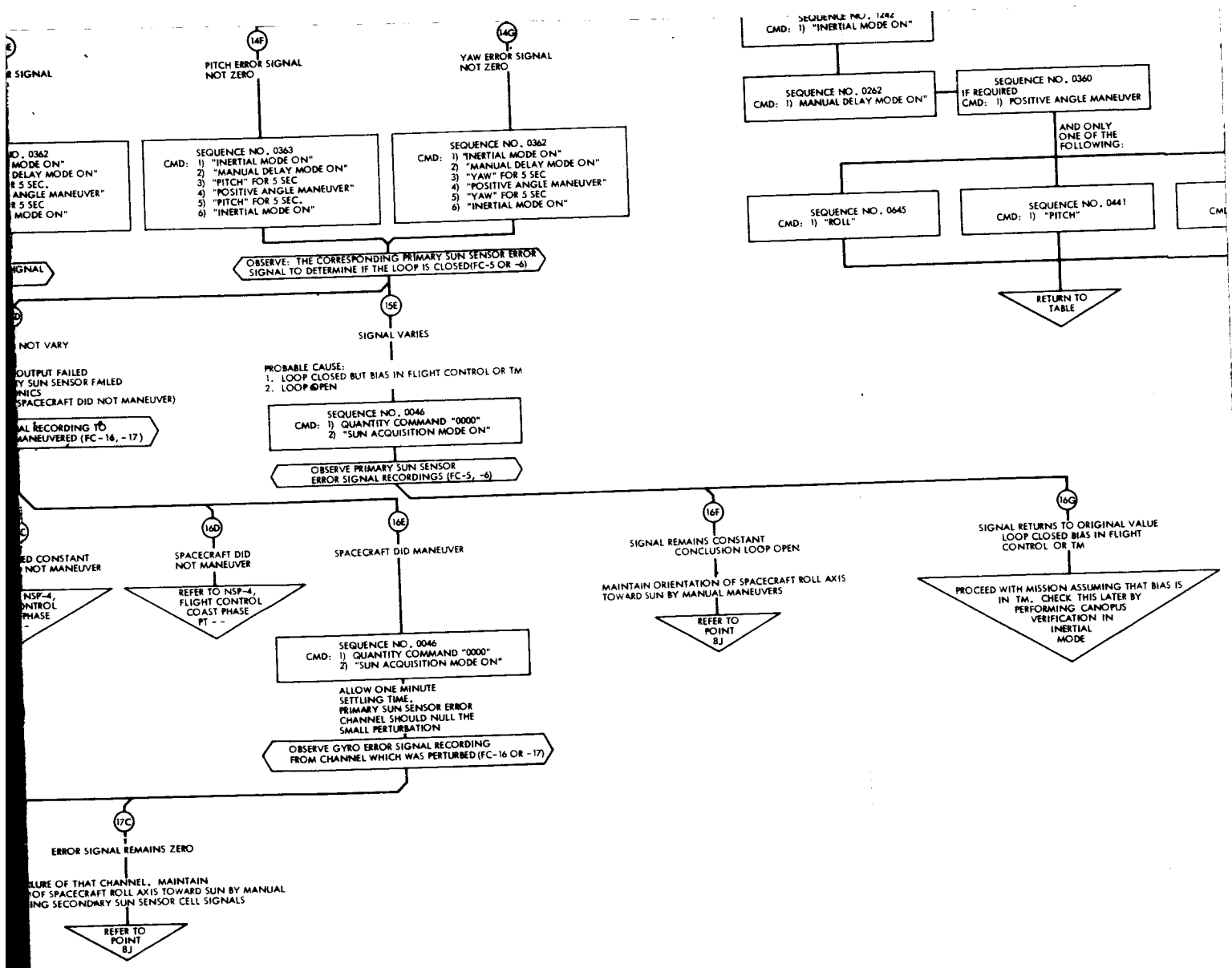
17B

ERROR SIGNAL NOT ZERO INITIALLY BUT GOES TO ZERO

INDICATES TELEMETRY OUTPUT FAILED
ERROR CHANNEL OK

RETURN TO POINT 14A

INDICATES FA
ORIENTATION
MANEUVER US

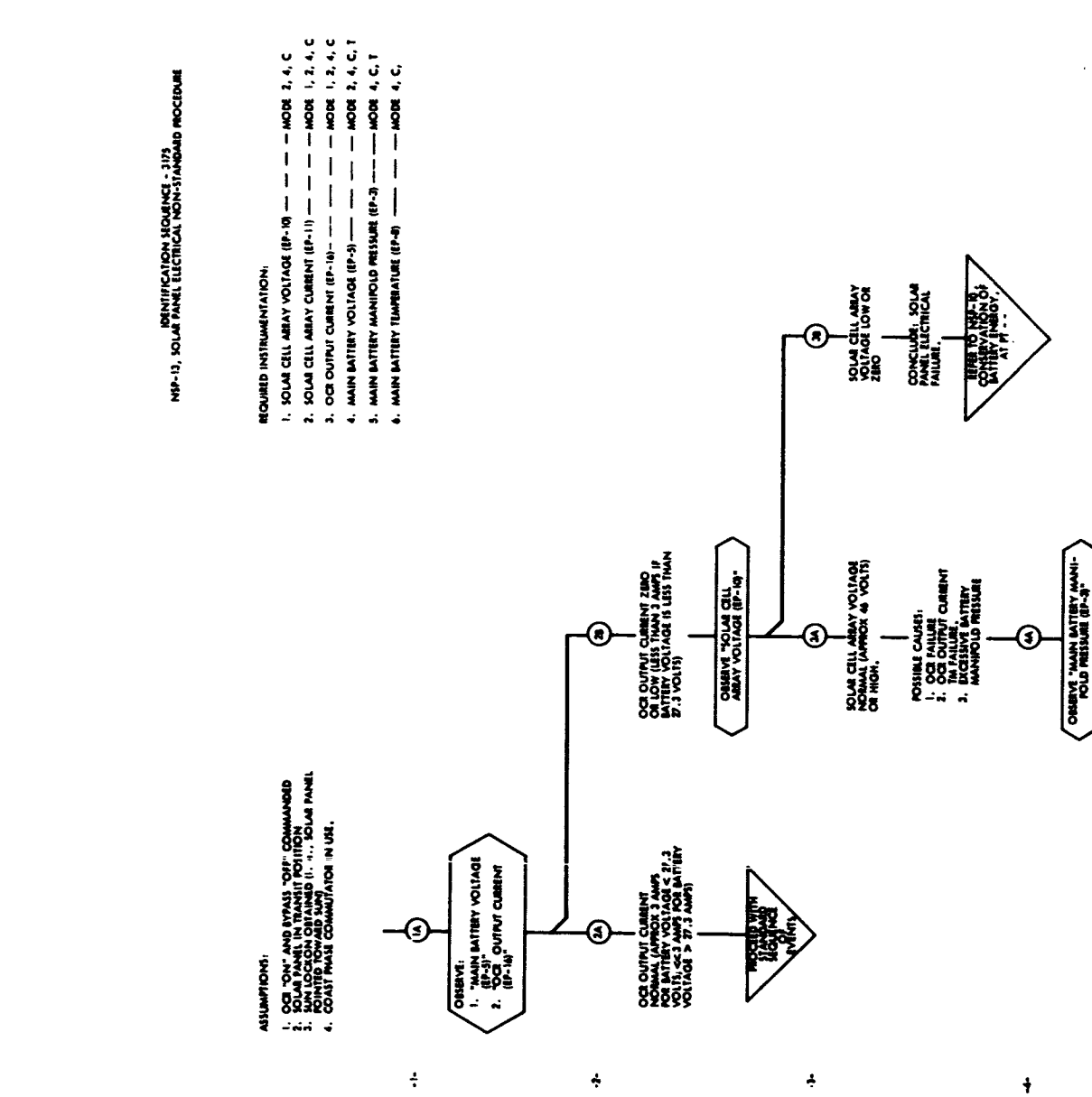

SIGNAL
14F
PITCH ERROR SIGNAL NOT ZERO
14G
YAW ERROR SIGNAL NOT ZERO
SEQUENCE NO. 1242
CMD: 1) "INERTIAL MODE ON"
SEQUENCE NO. 0262
CMD: 1) MANUAL DELAY MODE ON"
SEQUENCE NO. 0360
IF REQUIRED
CMD: 1) POSITIVE ANGLE MANEUVER
AND ONLY ONE OF THE FOLLOWING:
SEQUENCE NO. 0645
CMD: 1) "ROLL"
SEQUENCE NO. 0441
CMD: 1) "PITCH"
RETURN TO TABLE
SEQUENCE NO. 0362
CMD: 1) "INERTIAL MODE ON"
MODE ON"
DELAY MODE ON"
R 5 SEC.
ANGLE MANEUVER"
R 5 SEC
MODE ON"
SEQUENCE NO. 0363
CMD: 1) "INERTIAL MODE ON"
2) "MANUAL DELAY MODE ON"
3) "PITCH" FOR 5 SEC
4) "POSITIVE ANGLE MANEUVER"
5) "PITCH" FOR 5 SEC.
6) "INERTIAL MODE ON"
SEQUENCE NO. 0362
CMD: 1) "INERTIAL MODE ON"
2) "MANUAL DELAY MODE ON"
3) "YAW" FOR 5 SEC
4) "POSITIVE ANGLE MANEUVER"
5) "YAW" FOR 5 SEC
6) "INERTIAL MODE ON"
OBSERVE: THE CORRESPONDING PRIMARY SUN SENSOR ERROR SIGNAL TO DETERMINE IF THE LOOP IS CLOSED(FC-5 OR -6)
NOT VARY
OUTPUT FAILED
Y SUN SENSOR FAILED
NICS
SPACECRAFT DID NOT MANEUVER)
AL RECORDING TO
ANEUVERED (FC-16, -17)
15E
SIGNAL VARIES
PROBABLE CAUSE:
1. LOOP CLOSED BUT BIAS IN FLIGHT CONTROL OR TM
2. LOOP OPEN
SEQUENCE NO. 0046
CMD: 1) QUANTITY COMMAND "0000"
2) "SUN ACQUISITION MODE ON"
OBSERVE PRIMARY SUN SENSOR ERROR SIGNAL RECORDINGS (FC-5, -6)
ED CONSTANT
NOT MANEUVER
NSP-4,
ONTROL
PHASE
16D
SPACECRAFT DID NOT MANEUVER
REFER TO NSP-4, FLIGHT CONTROL COAST PHASE PT - -
16E
SPACECRAFT DID MANEUVER
SEQUENCE NO. 0046
CMD: 1) QUANTITY COMMAND "0000"
2) "SUN ACQUISITION MODE ON"
ALLOW ONE MINUTE SETTLING TIME. PRIMARY SUN SENSOR ERROR CHANNEL SHOULD NULL THE SMALL PERTURBATION
OBSERVE GYRO ERROR SIGNAL RECORDING FROM CHANNEL WHICH WAS PERTURBED (FC-16 OR -17)
16F
SIGNAL REMAINS CONSTANT
CONCLUSION LOOP OPEN
MAINTAIN ORIENTATION OF SPACECRAFT ROLL AXIS TOWARD SUN BY MANUAL MANEUVERS
REFER TO POINT 8J
16G
SIGNAL RETURNS TO ORIGINAL VALUE
LOOP CLOSED BIAS IN FLIGHT CONTROL OR TM
PROCEED WITH MISSION ASSUMING THAT BIAS IS IN TM. CHECK THIS LATER BY PERFORMING CANOPUS VERIFICATION IN INERTIAL MODE
17C
ERROR SIGNAL REMAINS ZERO
LURE OF THAT CHANNEL. MAINTAIN
OF SPACECRAFT ROLL AXIS TOWARD SUN BY MANUAL
ING SECONDARY SUN SENSOR CELL SIGNALS
REFER TO POINT 8J

SEQUENCE NO. 0440
1) "YAW"

13th

15#

FIGURE VI-6. NSP-12 SUN ACQUISITION
NONSTANDARD PROCEDURE


IDENTIFICATION SEQUENCE - 2175
NSP-13, SOLAR PANEL ELECTRICAL NON-STANDARD PROCEDURE
ASSUMPTIONS:
1. OCI "ON" AND BYPASS "OFF" COMMANDED
2. SOLAR PANEL IN TRANSIT POSITION
3. SUN LOCATION OBTAINED (i. e., SOLAR PANEL POINTED TOWARD SUN)
4. COAST PHASE COMMUTATOR IN USE.
REQUIRED INSTRUMENTATION:
1. SOLAR CELL ARRAY VOLTAGE (EP-10) — — — — MODE 2, 4, C
2. SOLAR CELL ARRAY CURRENT (EP-11) — — — — MODE 1, 2, 4, C
3. OCI OUTPUT CURRENT (EP-10)— — — — — MODE 1, 2, 4, C
4. MAIN BATTERY VOLTAGE (EP-5) — — — — MODE 2, 4, C, T
5. MAIN BATTERY MANIFOLD PRESSURE (EP-2) — — — MODE 4, C, T
6. MAIN BATTERY TEMPERATURE (EP-8) — — — — MODE 4, C,
OBSERVE:
1. "MAIN BATTERY VOLTAGE (EP-5)"
2. "OCI OUTPUT CURRENT (EP-10)"
OCI OUTPUT CURRENT NORMAL (APPROX 3 AMPS FOR BATTERY VOLTAGE < 27.3 VOLTS), (< 3 AMPS FOR BATTERY VOLTAGE > 27.3 AMPS)
PROCEED WITH LAUNCH SEQUENCE PROCEDURE
OCI OUTPUT CURRENT ZERO OR LOW (LESS THAN 2 AMPS IF BATTERY VOLTAGE IS LESS THAN 27.3 VOLTS)
OBSERVE "SOLAR CELL ARRAY VOLTAGE (EP-10)"
SOLAR CELL ARRAY VOLTAGE NORMAL (APPROX 48 VOLTS) OR HIGH.
POSSIBLE CAUSES:
1. OCI FAILURE
2. OCI OUTPUT CURRENT IN FAILURE
3. EXCESSIVE BATTERY MANIFOLD PRESSURE
OBSERVE "MAIN BATTERY MANIFOLD PRESSURE (EP-2)"
REFER TO NSP-6, CONSERVATION OF BATTERY ENERGY, AT PT --
SOLAR CELL ARRAY VOLTAGE LOW OR ZERO
CONCLUDE: SOLAR PANEL ELECTRICAL FAILURE.
1A
2A
2B
3A
3B
4A
4B

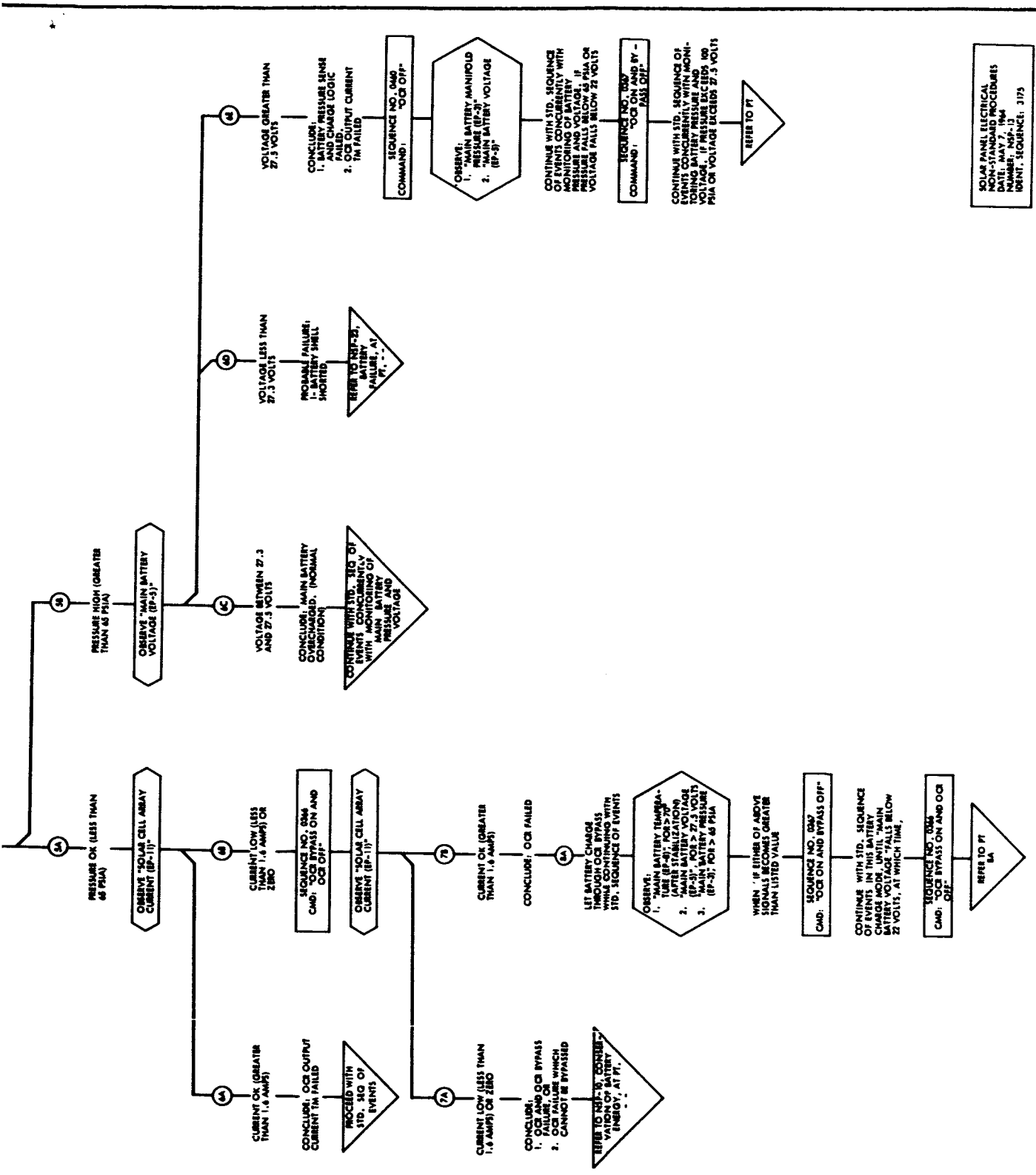



FIGURE VI-7. NSP-13, SOLAR PANEL ELECTRICAL NONSTANDARD PROCEDURE

IDENTIFICATION SEQUENCE NO. 3176
STAR ACQUISITION NON-STANDARD PROCEDURE NSP-14

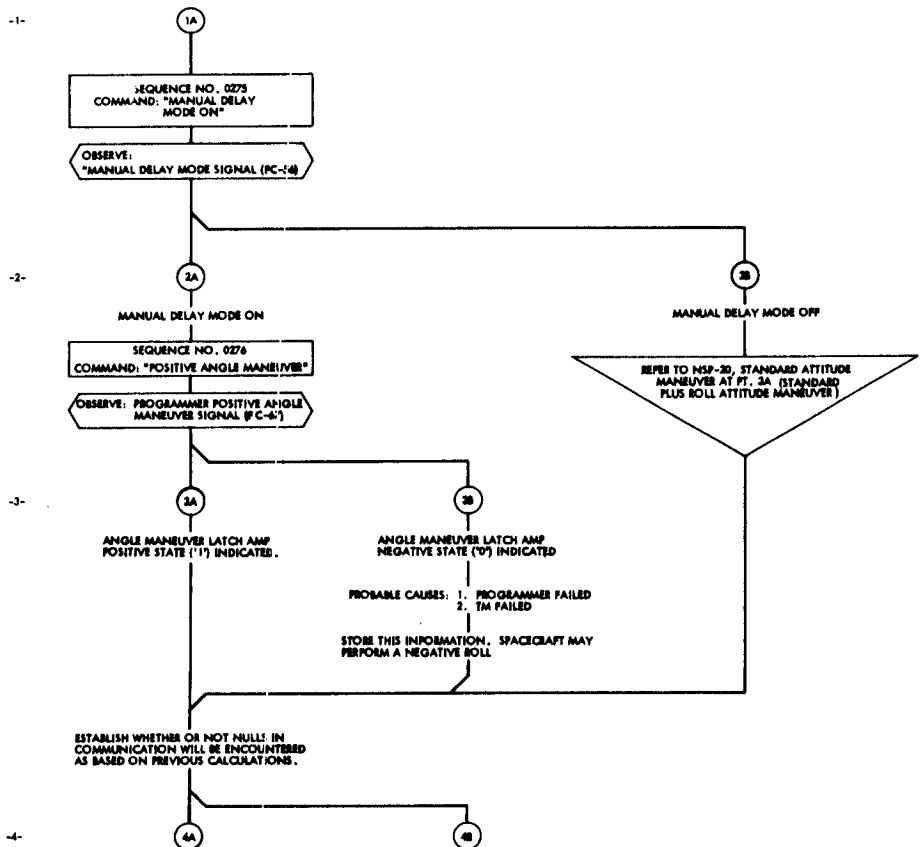
ASSUMPTIONS:

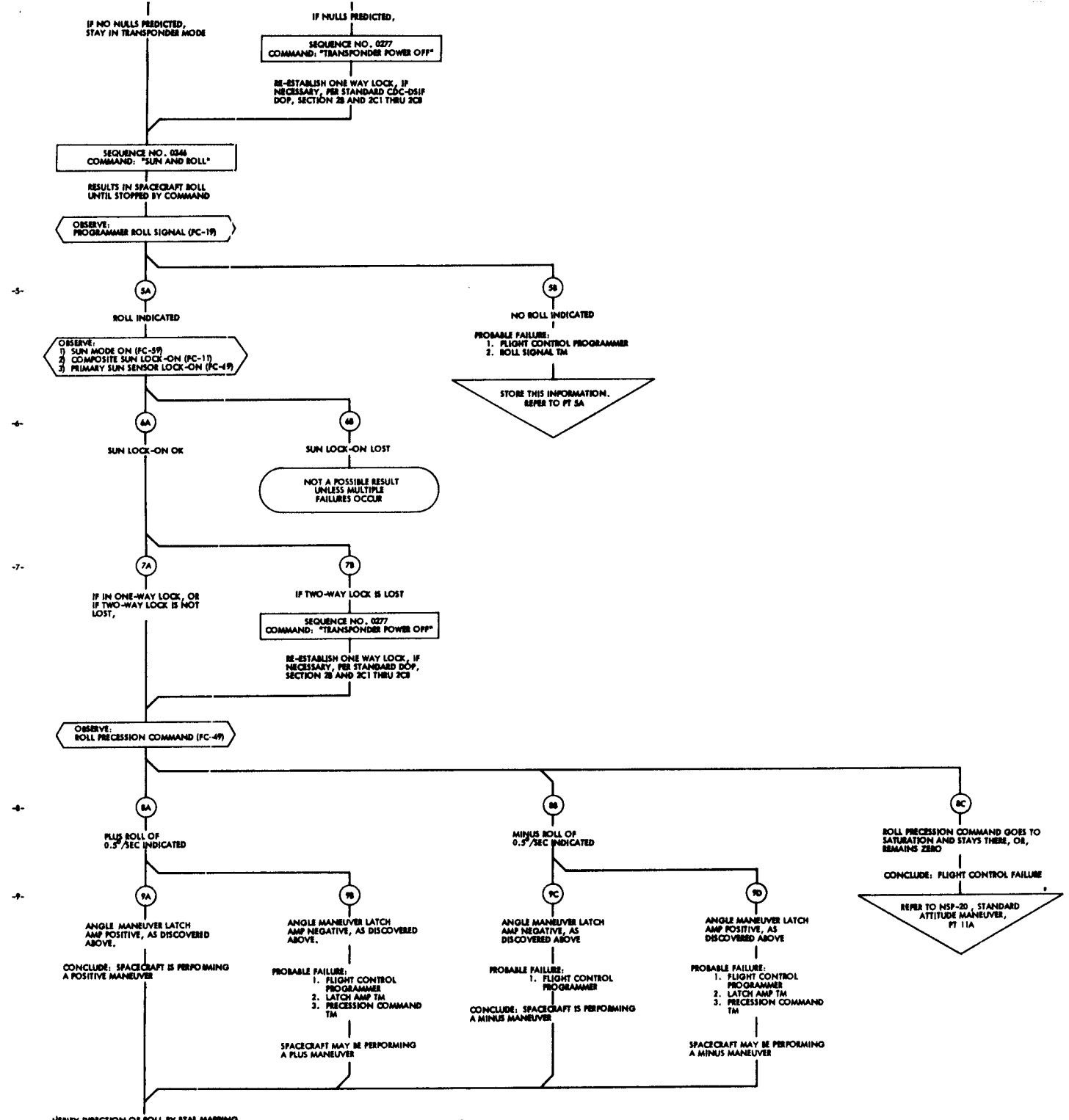
1. DSIF HAS ACQUIRED AND TWO-WAY COMMUNICATIONS ARE ESTABLISHED
2. SOLAR PANEL IS ERECTED TO TRANSIT POSITION, SUN LOCK HAS BEEN COMPLETED AND SPACECRAFT ROLL AXIS (NEGATIVE Z AXIS) IS ALIGNED TO SUN LINE.
3. FLIGHT CONTROL SYSTEM IS IN SUN MODE.
4. TELEMETRY OPERATION IS IN ENGINEERING MODE 1, 550 BPS
5. CONSERVATION OF GAS IS PRIME CONSIDERATION; TIME IS SECONDARY TO IT.
6. IT HAS BEEN DETERMINED WHETHER OR NOT THE SPACECRAFT-EARTH VECTOR WILL PASS THROUGH ANY OMNI-ANTENNA NULLS DURING A ROLL MANEUVER AND COMMUNICATION WILL DROP BELOW THRESHOLD LEVEL. (BASED ON DB MARGIN AND THE OMNI-ANTENNA GAIN PATTERNS.)

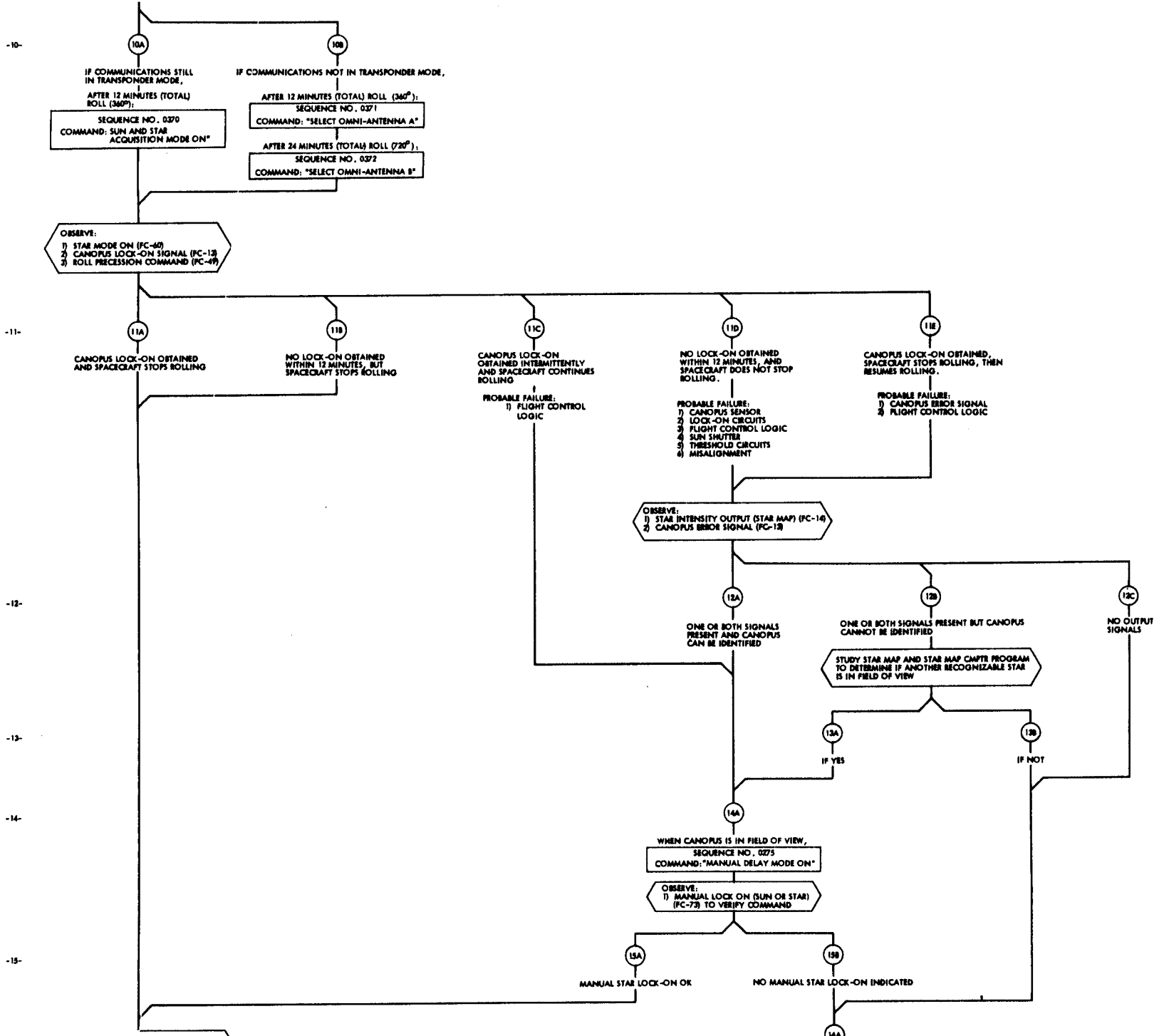
NOTE: 1) RADIATION MAY DEGRADE CANOPUS SENSOR OPERATION. REPEAT OPERATION IS AT A LATER TIME IF RADIATION IS SUSPECTED AS A CAUSE.
2) USE EDIT MODE 7 IF LINE TO SFCF CANNOT ACCOMODATE 550 BPS.

REQUIRED INSTRUMENTATION

| | MODES | DATA CHANNEL |
|---|---|---|
| 1. COMPOSITE SUN SENSOR LOCK-ON | 1,2,4,C,T | FC-11 |
| 2. CANOPUS ERROR SIGNAL | 1,C | FC-12 |
| 3. CANOPUS LOCK-ON SIGNAL | 1,2,4,C,T | FC-13 |
| 4. STAR INTENSITY SIGNAL | 1,C | FC-14 |
| 5. PROGRAMMER ROLL SIGNAL | 1,2,C,T | FC-19 |
| 6. ROLL PRECESSION COMMAND | 1,2,3,C,T | FC-49 |
| 7. MANUAL DELAY MODE SIGNAL | 1,2,4,C,T | FC-56 |
| 8. SUN MODE ON | 1,2,3,C,T | FC-59 |
| 9. STAR MODE ON | 1,2,3,C,T | FC-60 |
| 10. PROGRAMMER POSITIVE ANGLE MANEUVER SIGNAL | 1,2,C,T | FC-67 |
| 11. PRIMARY SUN SENSOR LOCK-ON | 1,2,3,C,T | FC-69 |




IF NO NULLS PREDICTED, STAY IN TRANSPONDER MODE
IF NULLS PREDICTED,
SEQUENCE NO. 0277 COMMAND: "TRANSPONDER POWER OFF"
RE-ESTABLISH ONE WAY LOCK, IF NECESSARY, PER STANDARD CDC-DSIF DOP, SECTION 2B AND 2C1 THRU 2C8
SEQUENCE NO. 0346 COMMAND: "SUN AND ROLL"
RESULTS IN SPACECRAFT ROLL UNTIL STOPPED BY COMMAND
OBSERVE: PROGRAMMER ROLL SIGNAL (PC-19)
-5-
5A
ROLL INDICATED
5B
NO ROLL INDICATED
PROBABLE FAILURE:
1. FLIGHT CONTROL PROGRAMMER
2. ROLL SIGNAL TM
STORE THIS INFORMATION. REFER TO PT 5A
OBSERVE:
1) SUN MODE ON (FC-59)
2) COMPOSITE SUN LOCK-ON (PC-11)
3) PRIMARY SUN SENSOR LOCK-ON (PC-49)
-6-
6A
SUN LOCK-ON OK
6B
SUN LOCK-ON LOST
NOT A POSSIBLE RESULT UNLESS MULTIPLE FAILURES OCCUR
-7-
7A
IF IN ONE-WAY LOCK, OR IF TWO-WAY LOCK IS NOT LOST,
7B
IF TWO-WAY LOCK IS LOST
SEQUENCE NO. 0277 COMMAND: "TRANSPONDER POWER OFF"
RE-ESTABLISH ONE WAY LOCK, IF NECESSARY, PER STANDARD DOP, SECTION 2B AND 2C1 THRU 2C8
OBSERVE: ROLL PRECESSION COMMAND (FC-49)
-8-
8A
PLUS ROLL OF 0.5°/SEC INDICATED
8B
MINUS ROLL OF 0.5°/SEC INDICATED
8C
ROLL PRECESSION COMMAND GOES TO SATURATION AND STAYS THERE, OR, REMAINS ZERO
CONCLUDE: FLIGHT CONTROL FAILURE
REFER TO NSP-20, STANDARD ATTITUDE MANEUVER, PT 11A
-9-
9A
ANGLE MANEUVER LATCH AMP POSITIVE, AS DISCOVERED ABOVE.
9B
ANGLE MANEUVER LATCH AMP NEGATIVE, AS DISCOVERED ABOVE.
9C
ANGLE MANEUVER LATCH AMP NEGATIVE, AS DISCOVERED ABOVE
9D
ANGLE MANEUVER LATCH AMP POSITIVE, AS DISCOVERED ABOVE
CONCLUDE: SPACECRAFT IS PERFORMING A POSITIVE MANEUVER
PROBABLE FAILURE:
1. FLIGHT CONTROL PROGRAMMER
2. LATCH AMP TM
3. PRECESSION COMMAND TM
SPACECRAFT MAY BE PERFORMING A PLUS MANEUVER
PROBABLE FAILURE:
1. FLIGHT CONTROL PROGRAMMER
CONCLUDE: SPACECRAFT IS PERFORMING A MINUS MANEUVER
PROBABLE FAILURE:
1. FLIGHT CONTROL PROGRAMMER
2. LATCH AMP TM
3. PRECESSION COMMAND TM
SPACECRAFT MAY BE PERFORMING A MINUS MANEUVER


-10-
10A
IF COMMUNICATIONS STILL IN TRANSPONDER MODE,
AFTER 12 MINUTES (TOTAL) ROLL (360°):
SEQUENCE NO. 0370
COMMAND: SUN AND STAR ACQUISITION MODE ON"
10B
IF COMMUNICATIONS NOT IN TRANSPONDER MODE,
AFTER 12 MINUTES (TOTAL) ROLL (360°):
SEQUENCE NO. 0371
COMMAND: "SELECT OMNI-ANTENNA A"
AFTER 24 MINUTES (TOTAL) ROLL (720°):
SEQUENCE NO. 0372
COMMAND: "SELECT OMNI-ANTENNA B"
OBSERVE:
1) STAR MODE ON (FC-60)
2) CANOPUS LOCK-ON SIGNAL (FC-12)
3) ROLL PRECESSION COMMAND (FC-49)
-11-
11A
CANOPUS LOCK-ON OBTAINED AND SPACECRAFT STOPS ROLLING
11B
NO LOCK-ON OBTAINED WITHIN 12 MINUTES, BUT SPACECRAFT STOPS ROLLING
11C
CANOPUS LOCK-ON OBTAINED INTERMITTENTLY AND SPACECRAFT CONTINUES ROLLING
PROBABLE FAILURE:
1) FLIGHT CONTROL LOGIC
11D
NO LOCK-ON OBTAINED WITHIN 12 MINUTES, AND SPACECRAFT DOES NOT STOP ROLLING.
PROBABLE FAILURE:
1) CANOPUS SENSOR
2) LOCK-ON CIRCUITS
3) FLIGHT CONTROL LOGIC
4) SUN SHUTTER
5) THRESHOLD CIRCUITS
6) MISALIGNMENT
11E
CANOPUS LOCK-ON OBTAINED, SPACECRAFT STOPS ROLLING, THEN RESUMES ROLLING.
PROBABLE FAILURE:
1) CANOPUS ERROR SIGNAL
2) FLIGHT CONTROL LOGIC
OBSERVE:
1) STAR INTENSITY OUTPUT (STAR MAP) (FC-14)
2) CANOPUS ERROR SIGNAL (FC-13)
-12-
12A
ONE OR BOTH SIGNALS PRESENT AND CANOPUS CAN BE IDENTIFIED
12B
ONE OR BOTH SIGNALS PRESENT BUT CANOPUS CANNOT BE IDENTIFIED
STUDY STAR MAP AND STAR MAP CMPTR PROGRAM TO DETERMINE IF ANOTHER RECOGNIZABLE STAR IS IN FIELD OF VIEW
12C
NO OUTPUT SIGNALS
-13-
13A
IF YES
13B
IF NOT
-14-
14A
WHEN CANOPUS IS IN FIELD OF VIEW,
SEQUENCE NO. 0275
COMMAND: "MANUAL DELAY MODE ON"
OBSERVE:
1) MANUAL LOCK ON (SUN OR STAR) (FC-73) TO VERIFY COMMAND
-15-
15A
MANUAL STAR LOCK-ON OK
15B
NO MANUAL STAR LOCK-ON INDICATED

CANOPUS ERROR SIGNAL (PC-12) RECORDING

PROCEED WITH MISSION EXCEPT SPACECRAFT MUST BE MANUALLY ROLLED TO POINT PLANAR ARRAY AT EARTH WHENEVER ACCURATE ATTITUDE REFERENCE IS REQUIRED. REFER TO NSP-15, "PLANAR ARRAY AS ROLL ATTITUDE REFERENCE, PT. LANDING POINT ACCURACY AND PROBABILITY OF SOFT LANDING WILL BE SLIGHTLY REDUCED"

-17-

17A

CANOPUS ERROR SIGNAL WENT THRU MAXIMUM AND IS NOW ZERO

17B

CANOPUS ERROR SIGNAL WENT THRU VARIATIONS AND STOPPED (NOT AT ZERO)

PROBABLE FAILURE:
1) BIAS IN FLIGHT CONTROL
2) BIAS IN TM
3) LOOP NOT CLOSED

SEQUENCE NO. 0373
COMMAND: 1) "MANUAL DELAY MODE"
2) "SUN AND ROLL" FOR 5 SECONDS, THEN
3) "SUN AND STAR"

OBSERVE: ROLL PRECESSION COMMAND (PC-49) TO SEE IF LOOP IS CLOSED.

17C

CANOPUS ERROR SIGNAL ALWAYS ZERO

PROBABLE FAILURE:
1) CANOPUS ERROR CIRCUITS
2) TM

SEQUENCE NO. 0373
COMMAND: 1) "MANUAL DELAY MODE"
2) "SUN AND ROLL" FOR 5 SECONDS, THEN
3) "SUN AND STAR"

OBSERVE: ROLL PRECESSION COMMAND (PC-49) TO SEE IF LOOP IS CLOSED

-18-

18A

IF IT IS:

CORRELATE CANOPUS ERROR SIGNAL WITH STAR INTENSITY SIGNAL TO DETERMINE IF BIAS IS IN TM OR IN FLIGHT CONTROL

IF BIAS IS IN TM:

IF BIAS IS IN FLIGHT CONTROL:

18B

IF IT IS NOT:

18C

IF IT IS:

RETURN TO PT 20A

18D

IF IT IS NOT:

RETURN TO PT 16A

-19-

19A

DETERMINE POLARITY OF CANOPUS ERROR SIGNAL (DEGREES OF ROLL)

-20-

20A

OBSERVE:

PLOT OF STAR INTENSITY SIGNAL (FC-14) VERSUS ROLL ANGLE (STAR MAP) TO VERIFY THAT STAR ACQUIRED IS ACTUALLY CANOPUS

20B

IF IT IS POSITIVE:

SEQUENCE NO. 0374
COMMAND: 1) "MANUAL DELAY MODE"
2) "SUN AND ROLL"
WHEN CANOPUS IS IN FIELD OF VIEW, COMMAND:
3) "SUN MODE"

20C

IF IT IS NEGATIVE:

SEQUENCE NO. 0375
COMMAND: 1) "MANUAL DELAY MODE"
2) "POSITIVE ANGLE MANEUVER"
3) "SUN AND ROLL"
WHEN CANOPUS IS IN FIELD OF VIEW, COMMAND:
4) "SUN MODE"

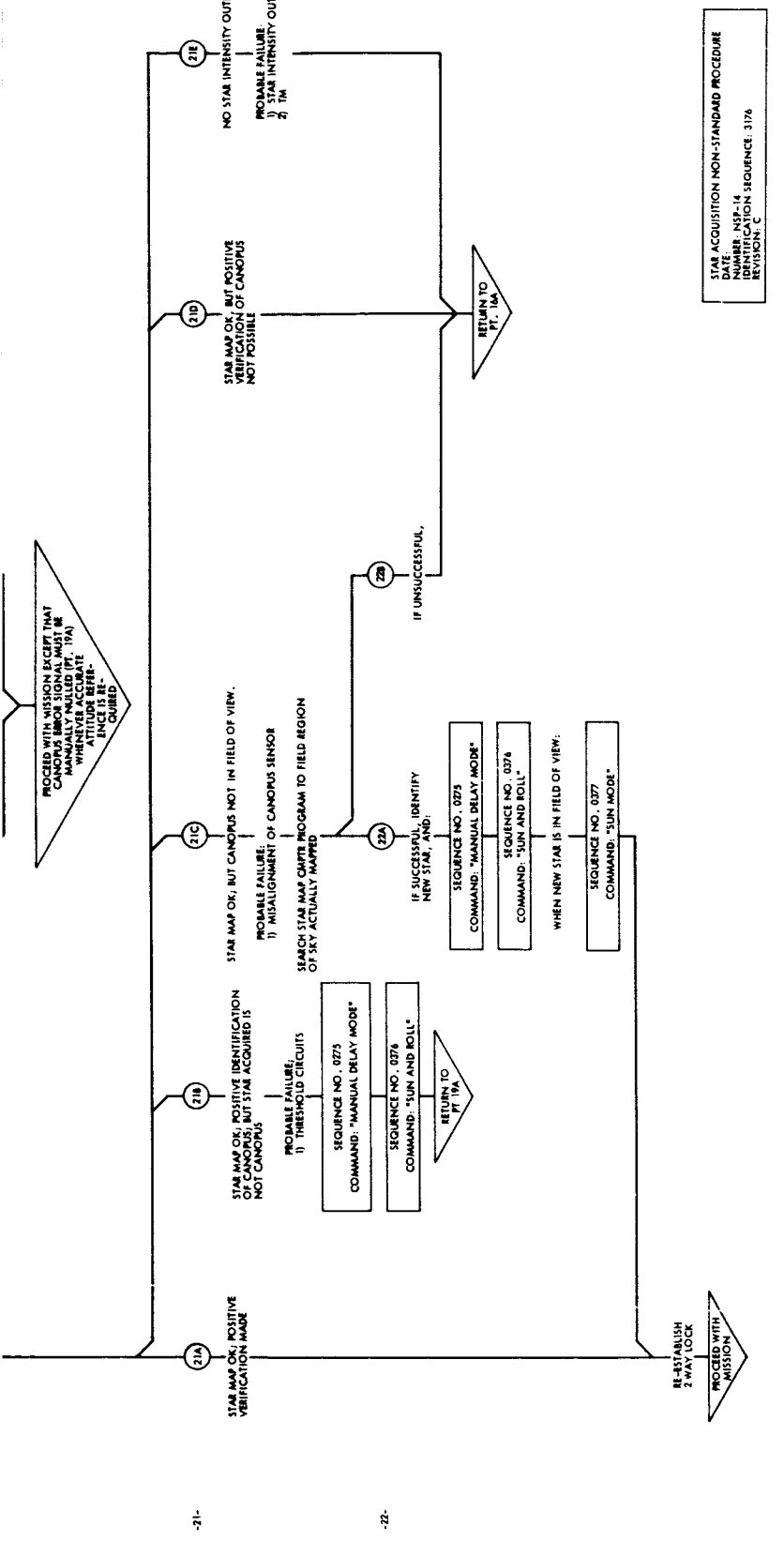



FIGURE VI-8. STAR ACQUISITION NON-STANDARD PROCEDURE NSP-14